SCIENTIFIC AMERICAN

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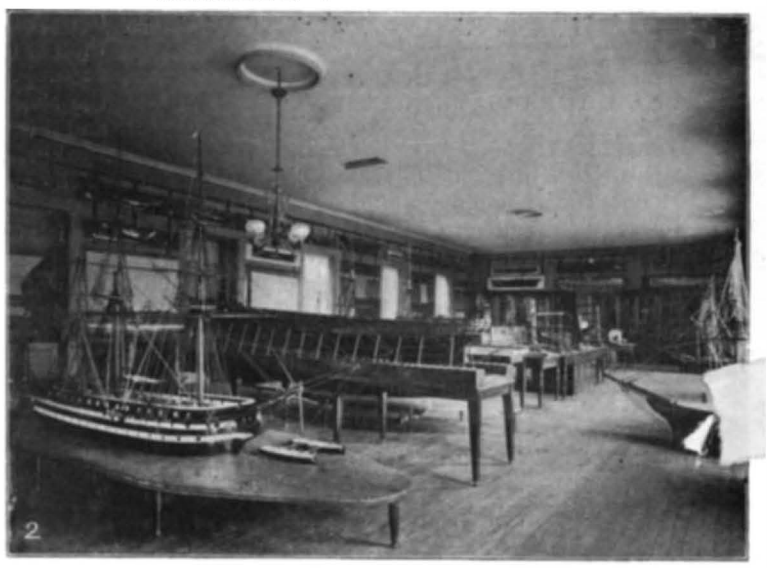

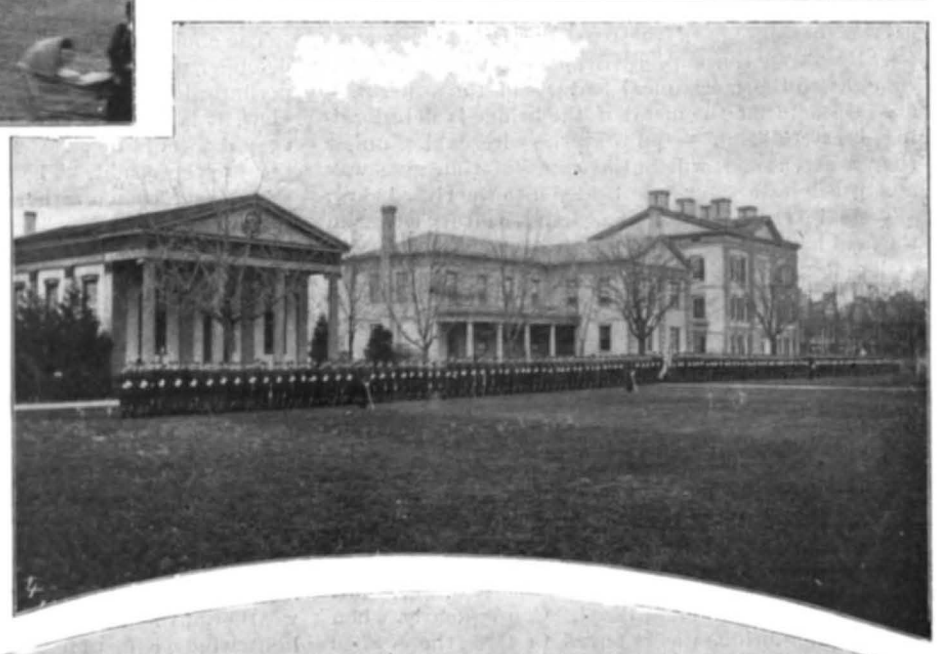

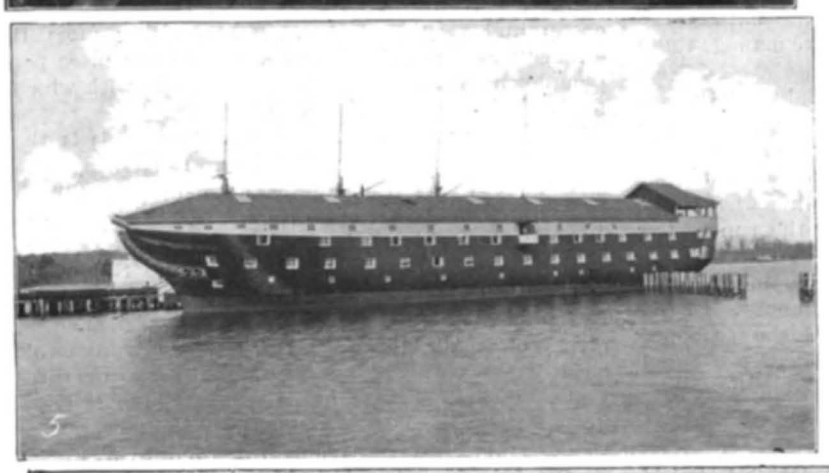

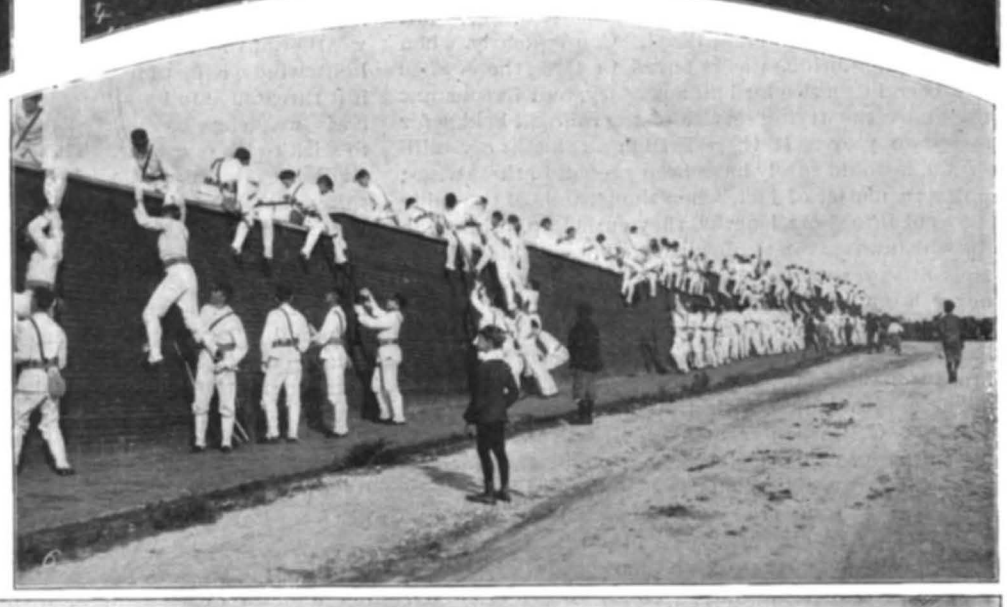

Photographs by M. M. Casler, Annapolis, Md.

1. New cadets' quarters. 2. Seamanship department. 3. Gun deck U. S. S. "Santee." 4. Recitation Hall, Seamanship building, and United States Naval Institute building; cadets on dress parade. 5. The U. S. S. "Santee." 6. Scaling wall by naval cadets. 7. Stribling Row and Recitation Hall.

UNITED STATES NAVAL ACADEMY, ANNAPOLIS.—[See page 283.]

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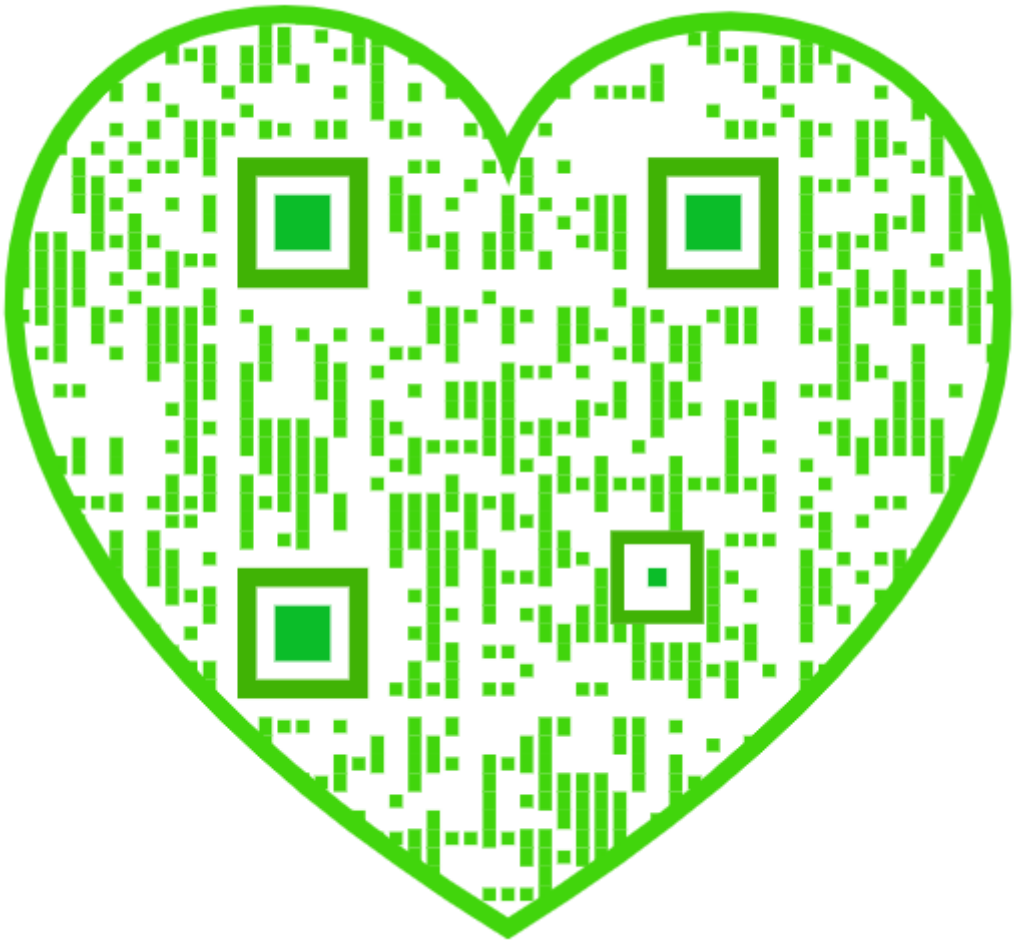

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NEW YORK, SATURDAY, MAY 6, 1899.

CRYSTALLIZATION OF METAL UNDER STRESS.

The persistence with which an exploded theory maintains its hold on the public mind was shown incidentally during the recent attack by the city government upon the Manhattan Elevated Railway Company. In the newspaper discussion which was aroused by that unparalleled exhibition, the venerable bogy of the crystallization of steel and iron in bridge structures was trotted out, and the imminent collapse of the elevated columns, trusses, and girders was once more predicted. It would be difficult to find a popular engineering fallacy that maintains its hold on the public mind with greater tenacity than this; it is certainly impossible to find one that has less foundation in fact and is more completely disproved by the condition of the metal in long-standing steel and iron bridges at the time of their removal or renewal. It is probable that a large percentage of the passengers that daily cross the Brooklyn Suspension Bridge—if they give any thought to the mechanical features of the structure—are satisfied that the metal of the bridge is deteriorating—"crystallizing"—and that the wire cables, unless they are renewed, will in the course of time give way and precipitate the whole bridge into the river below.

Tests in the laboratory and half a century's tests in the field have proved that the theory of the crystallization of metal under ordinary static stresses is a myth. The stresses, of course, must not exceed or even approach the elastic limit of the material; but as long as they remain well within this limit, there is no reason, as far as our present theory and practice can enlighten us, why a properly inspected and painted bridge should not last indefinitely. A strong presumption to this effect is afforded by the experience of the engineers who had charge of the recent reconstruction of the railway wire suspension bridge across the Niagara gorge. The original structure was erected by Mr. Roebling, of Brooklyn Bridge fame, in 1853, and in making the cables, the wires of an earlier bridge, built at this site in 1848, were utilized. Consequently, when the Roebling bridge was removed in 1898, these wires had been in service for half a century, and in constant use under the trying service of the railroad bridge for forty-two years. If there is such a thing as crystallization, it would surely have been present in these wires; but, as a matter of fact, when the strands of the cable were cut into short lengths, they curled up, taking the set which was given them when they were coiled on the reels fifty years ago. This proves that the cables had never been overstrained, and that the static strains due to the weight of the bridge, and all the rolling loads of cars and locomotives for over forty years had failed to produce any injury to the material.

These facts agree with the careful tests made by Prof. R. C. Carpenter at Cornell University, which verify the growing belief among engineers that the theory that crystallization can be produced by rapidly applied stress is no longer tenable. The subject was examined by a wide variety of methods, each of which might be supposed to produce the injurious crystalline condition. The test specimens were subjected to sudden stress by moving weights; to shocks due to explosives; to fracture by blows after a number of alternate heatings and coolings; and finally to a large number of blows of small force. It was found that so far from the suddenness of the stress tending to crystallize the material, the elongation or elastic stretch of the material was greatest when the stress was most suddenly applied. The importance of this result on the question of bridge deterioration is evident, for the distrust of this form of structure is due to the fact that its load, particularly in the case of railroad bridges, is suddenly applied and has something of a dynamic effect.

These investigations also served to correct the popular impression that steel and iron are more liable to failure in winter than in summer, and that metals generally are rendered "brittle" by a lowering of their temperature. As a matter of fact, the strength of wrought iron and steel is at a minimum at 70° F., and it increases with a variation of temperature either way from this point, increasing with a rise of temperature until it is 20 per cent stronger at 500° F., and being also about 20 per cent stronger at 60° below zero F. It is remarkable also that the tests should have shown that with the increased intensity of the cold there was a perceptible rise in the elastic limit.

That increased cold should not only have increased the hardness of the steel, but also its ductility, is directly at variance with the popular belief, which is based largely upon the fact that in railroad operation it has been observed that rails, wheels, and axles fail more readily in cold than in hot weather. There is no question that failures are more frequent in frosty weather, and in the light of the Cornell experiments, we must now look for some other cause of the phenomena. It is to be found in the fact that in winter, the roadbed being frozen and inelastic, the hammering of the rails by the heavily loaded wheels is more severe than in the summer, when the ballast has regained its natural elasticity. The same cause operates to increase the shocks to which the wheels and axles are subject, and it is to this extra stress, and not to any inherent weakness, that the failures are due.

The subject of the deterioration of structural iron under stress has much more than an academic interest, for it affects not merely the costly and indispensable bridges which form important links in our great systems of transportation, but all the modern fireproof buildings, the vast roofs of our terminal stations and exhibition halls, and every form of framed structure that is subject to stress, whether from wind or loads. It is satisfactory to feel assured that, as far as our present knowledge goes, there is no reason why, with careful inspection to prevent its oxidation by the weather, the metal of such structures as the Brooklyn and Forth Bridges should not last as indefinitely as if it lay embedded in the ore from which it was drawn.

THE YACHT "COLUMBIA."

The choice of the name "Columbia" for the new cup defender will probably give general satisfaction, and perhaps, looking at the question from every point of view, it is better than "Golden Rod," which it was thought would be selected by those who are responsible for the yacht. The name of a national flower would have been a rather happy reply to the choice of the name "Shamrock" by the owner of the challenging boat; but "Columbia" is better because more national and distinctive.

It may not be known to many of our readers that the new yacht will not be the first cup defender to bear the name "Columbia." In the year 1871, an Englishman, Mr. James Ashbury, forwarded his second challenge for a race (his first attempt to win the cup having been made unsuccessfully in the previous year), and brought over a new racing schooner, the "Livonia," which had been built specially for the contest. The "Columbia," a typical American schooner yacht, was selected to meet her and sail a series of seven races. In those days the cup committee reserved the right to select any one of several yachts to suit the particular weather of the day. If the day of the race brought light winds, a fast fair weather boat was selected, and if it threatened to blow "greatguns," a more weatherly craft was chosen, the challenger, meanwhile, having to stick to his one boat. This was pretty hard on the challenger, it must be confessed, and we manage those things better now.

In the first race the wind was light and the "Columbia" was chosen. She beat the "Livonia" over the New York Yacht Club course by 36 minutes 28 seconds. In the second race the wind was light at the start and "Columbia" was again chosen. The course was twenty miles to windward and return, and in the run to the outer mark the "Livonia" led. On the beat back to Sandy Hook lightship the "Columbia" gained 10 minutes and 33 seconds, winning by that amount. In the third race the wind was fresh, and the schooner "Dauntless" was selected, but an accident prevented her from starting, and the "Columbia" took her place. The strong breeze carried away one of her spars, and her steering gear gave way, necessitating her sailing under reduced canvas, with the result that the "Livonia" won by 15 minutes 10 seconds. In the two last races of the series the schooner "Sappho" was chosen, and she won the races by the comfortable margins of 30 minutes 21 seconds and 25 minutes 27 seconds. From the long lead with which the American schooners crossed the line, it is evident that if the defense of the cup had been confided to a single boat ("Columbia," for instance), as is now the practice, the result would have been the same.

We expect that the new "Columbia" will win, and we could wish that she might lead the "Shamrock" home by such handsome margins as her namesake did nearly thirty years ago; but it is not likely. Yacht designing was not the exact science in the seventies that it has grown to be in the nineties, and there is no such divergence now in hull and sail plan as distinguished the saucy schooners of that day. The types have slowly and surely drawn together by the inexorable law of the survival of the fittest; each has borrowed from the other, besides discarding what was useless and obsolete in its own practice, until to-day it takes the eye of an expert to tell a "Valkyrie" from a "Defender," or shall we say a "Columbia" from a "Shamrock."

From all that can be reliably gathered, the two new boats will be more alike than any two that preceded them. Both are constructed of an alloy, the home yacht of Tobin bronze and the challenger of phosphor bronze; and both are being built up to the full limit of size and power. There will probably be very little to choose in the matter of weight of the hulls, rigging, and spars, and, indeed, as far as the mere structural features are concerned, the race will scarcely be won by any great advantage so gained. The fortunes of the cup will depend on the form of the hulls, the sail plan, and, above all, on the skippers and crews that will handle these magnificent and costly yachts during the eventful days of next October.

THE USES OF FLORIDA MOSS.

The freeze of this year killed the Florida moss. People who do not recognize what this means must think that this somber gray drapery of the Southern forests gives one hundred bales a week of "moss hair" to the Northern upholsterers from the little village of Micanopy, Florida, alone, and other factories in the State yield many times as much, and this is only about one-half of the weight of the moss when taken from the trees. The other half is the useless envelope to the inner and valuable hair. There is a mistaken idea as to how the outer portion of the moss is removed. It is generally supposed that the covering is removed by chemicals or by passing through some ingenious stripping machine. The latter would be too expensive and the former open to the danger of injuring the natural elasticity of the fiber.

The moss when first gathered is greenish-gray. When killed by frost or lack of proper sustenance, it is easily distinguished from the live moss. It turns gray, and if bitten feels soft, while the live moss "crunches" between the teeth. But the outer covering will remain on either the dead or fresh moss for months. If the moss, either alive or killed, is simply piled in heaps in a moist place and covered with muck or sand, it soon begins to ferment. The temperature of the interior of the heap rises to a point too hot for the hand to bear, and, if not checked, it keeps heating till too hot to walk over. But this stage means damage to the interior hair, and must be avoided. Properly conducted, the fermentation means the complete destruction of the outer skin, and the moss is left duly "colored," i. e, showing the dark brown color of the hair.

It reaches this stage in the hands of the pickers, who then deliver it in loose wagon loads, like hay, to the gins. There are about fifty of these ginning establishments in the State—very simple affairs. The building is constructed as cheaply as possible and costing from $200 to $300—no insurance is obtainable. The floor is six feet from the ground and made of slats 1½ inches apart, so that short fibers, sticks, and dirt will sift out. In the building is nothing but a cheap modification of a cotton gin—a cylinder two feet long, and of the same diameter, with two-inch teeth, which beat the moss against similar stationary teeth, taking out sticks and rubbing off most of the adhering remains of the outer covering of the moss. The machine is cheap and very inefficient. The resulting moss is either "2 cent moss" or "3 cent moss"—the price per pound after ginning, according to the care with which the picker delivered it.

The writer was surprised to learn that this is the only preparation the moss receives. It is shipped in bales direct to the wholesaler, who generally distributes them unopened to the upholsterers.

The freeze will not interfere with this year's crop. The dead moss is treated just as before the freeze. But the outlook for next year is bad. The crop will be small. Usually where a tree has been picked clean, plenty of small bits are left, so that in a favorable locality the tree will be full again in two or three years. This was shown by the practice in moss localities of cleaning it from the orange trees every two years. But when the temperature fell to 8° in the center of the State last February, the moss was quite generally killed and its development so checked that the yield will be smaller for several years. South of Ocala little harm was done.

PROF. CHANDLER HONORED.

Prof. Charles F. Chandler, of the School of Mines of Columbia University, has been nominated for president by the Society of Chemical Industry, which has been in session at Glasgow. Prof. Chandler is the first American to be nominated for the president of an English scientific society. In his new office Prof. Chandler will succeed such men as Sir Henry Roscoe, Sir Frederick Abel, Sir John Evans, Sir Lowthian Bell, and others. Prof. Chandler is now sixty-one years of age. He graduated from Göttingen in 1856, and in 1864, in connection with Prof. Eggleston and Gen. Vinton, he founded the School of Mines of Columbia College. In 1866 he was appointed chemist for the Health Board of New York, and in 1873 to 1884 he was president of the Board. He is at present the expert for many corporations. When Prof. Chandler returns to the United States, a reception will be tendered him.

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TOPOGRAPHICAL MAPS.

The United States Geological Survey has been carrying on important work for the last sixteen years, important not only to scientists and engineers, but also to the public as well. This work consists of the preparation of topographical maps of various sections of the United States, from careful observations and surveys, and their subsequent publication and distribution. Already about one-quarter of the United States, exclusive of Alaska, has been mapped in this way, and it is the intention of the Geological Survey to issue maps covering the entire country. The Evening Post recently had an interesting article upon this particular branch of work carried on by the Geological Survey, from which we condense the following: In carrying on government and other engineering and scientific works, such as investigating water supply and irrigation, timber cultivation and transportation routes of all kinds, an accurate knowledge of the topography of the territory under consideration is one of the first essentials; and in arranging for the topographical survey of the country, the government decided that it should result in a series of maps which should be valuable as a basis of further scientific work. The maps are comparable with the military maps of Europe, as they furnish all the details of the country, including roads and watercourses. The maps are 16½×20 inches and are drawn on a scale of 1:62,500, or an inch to the mile. Surveys for the maps are made by the engineers of the Geological Survey under the supervision of the Director at Washington, and in many cases there has been co-operation between the national survey and the various State surveys.

The start is made with a primary triangulation obtained from the Coast and Geodetic Survey, in which certain primary points are located with mathematical accuracy. It is often necessary for the engineers of the Geological Survey to extend the primary triangulation of the coast survey and to do considerable triangulation, both primary and secondary, on their own account, so as to embrace the points needed for the territory which is being surveyed. After the triangulation is completed, the topographical party takes the field, and a topographer and two assistants occupy themselves with the section of country contained in a single sheet of map. The topographer, who has already located the principal heights in the district, sketches in the contour lines showing the different elevations, while the assistants use, where possible, a horse and buggy to measure the distances. The ponds, lakes, and water supply are carefully marked and the other topographical features are indicated on the field sheets, which are then taken to Washington, and a map drawn on a scale of one and one-half times as large as the printed sheet when issued. In Washington the survey has its own bureau of engraving and printing where the maps are engraved on copper. Changes are constantly being made in these copper sheets, and from them copper-plate maps are obtained; but these maps are not issued, however. They are simply used as copy for the photo-lithographers to make their maps, for the maps which are issued are printed from lithographer's stones. The sheets are printed in three colors, the cultural features, such as roads, cities, towns, and railroads, and also the lettering, being black, the water features blue, and the hill features brown. The contour lines indicate intervals of twenty feet. By an act of Congress these maps are disposed of by sale and they can be purchased at the rate of five cents each, or in quantities of a hundred or more for two cents per sheet. On application to the Director of the Geological Survey, a list of maps now published could be obtained which will enable bicyclists, tourists, or surveyors to purchase these valuable maps. Local atlases may be readily made by purchasing a number of these and binding them. These topographical maps are made parts of a series of geological volumes issued by the Survey.

MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The thirty-ninth meeting of the American Society of Mechanical Engineers will be held at Washington, D. C., May 9 to May 12, and the sessions of the society will be held in the Arlington Hotel. The opening session will take place on Tuesday evening, May 9, and an informal reception will be held by the president and officers of the society. This will take place in the Corcoran Gallery of Art. A second session will take place on Wednesday morning, and the reading of a number of professional papers. On Wednesday afternoon there will be held a reception of the society by President McKinley in the Executive Mansion at 3 P. M., and on Thursday morning professional papers will also be read, and in the afternoon an excursion will be made to the navy yard, where the gun factory, trial tank for ship models, ordnance museum, and ships will be visited. In the afternoon there will be a reception tendered to the society by Mrs. George Westinghouse, and after the closing session on Friday morning, papers will be read. In the afternoon an excursion will be made to Mount Vernon, and in the evening a visit will be paid to the Washington Monument, which will be lighted for the occasion, as will also be the Congressional Library, where an admirable opportunity will be given for inspecting the lighting and ventilating machinery and the book conveyors. The meeting promises to be one of unusual interest.

OZOTYPE.

A NOVEL METHOD OF CARBON PRINTING.

Although "carbon" is the most beautiful, the simplest, and most permanent of all printing methods, it has not, in this country at least, attained any considerable degree of popularity. For this there are several reasons, all more imaginary than real, with the exception, perhaps, of two. These are the invisibility of the printed image and the fact that the image is reversed, double transfer, simple as it is, seeming to frighten both amateur and professional. But if all that is claimed for this new method is true, both of those objectionable features will be abolished.

In the 1898 exhibition of the Royal Society there were two exhibits that attracted considerable attention and much speculation. They were by Mr. T. Manly, of London, and included prints in various colors, including pigments and aniline colors. In the catalogue they were entered as "Examples of ozotype printing in pigment, being carbon printing without actinometer, transfer or safe edge, and in which the pigmented gelatine does not come in contact with a chromic salt."

Up to March 23, that was all the information we had, but on the evening of that day Mr. Manly brought the subject before the Royal Society, by way of demonstration; and without going fully into it, gave sufficient information to enable any one to try his hand at it, promising to return to it when certain patent arrangements were completed.

The principle involved is the old, old one discovered by Ponton in 1839, the splitting up, by light, of chromium trioxide into chromium sesquioxide, and the rendering insoluble of soluble organic matter by the action of the nascent oxygen.

In the practical application of this to ozotype, paper is coated with a solution containing a chromate and a manganous salt, and exposed under a negative in the ordinary way, till a distinct image of a brown color is formed. The image is positive and is then washed in water till the unaltered salts are removed, and nothing but the positive image is left. The next step is to immerse the print and a piece of unsensitized carbon tissue in a solution containing acetic acid and hydroquinone or other suitable phenol derivative. They are then withdrawn and squeegeed together, and hung up to dry. When dry, they are placed for half an hour in cold water and then transferred to warm water, and developed as an ordinary carbon print.

A possible explanation of the changes that take place may be as follows: The oxygen liberated by the light from the chromate salt is absorbed by the manganous, which is converted into a manganic; and that oxygen is again liberated by the acetic acid, to be in turn absorbed by the gelatine. This absorbed oxygen, aided by the hydroquinone, renders the gelatine sufficiently insoluble to bear development, and so we have the positive picture, and of any color that we desire.

Until further notice, the following may be taken as an experimental working formula:

SENSITIZING SOLUTION.

Manganous sulphate	14 drams or parts.
Potassium bichromate	7 " "
Water	12 ounces or 100 parts.

This may be applied with a brush to any good plain paper, such as Whatman's, or a paper already coated with gelatine may be employed. If plain paper, then the dried print must be coated with two per cent solution of gelatine, and allowed to dry before immersion in the bath, which may be as follows:

Acetic acid glacial	3 grains.
Hydroquinone	1 "
Water	2 ounces.

The carbon tissue should be immersed in this for about one minute, taking care that no air bubbles are formed, and the print for only a few seconds; and if the tissue be cut just a little smaller than the print, there will be no chance of slipping while squeegeeing.

It will be evident that carbon tissue of any color may be used, and probably tissue colored by aniline, and that as there is a visible image and no sensitized tissue to spoil, there should be a great future before ozotype.

The following hints may be of use to experimenters:

When rough paper is used, printing should be carried a little deeper than with smooth.

For increasing contrasts, increase the acetic acid in the bath. For softness, increase the hydroquinone.

The addition of a small quantity of magnesium sulphate to the bath tends to solubility of the gelatine.

In case of an under-printed proof, immersion in a very weak solution chloride of lime may improve matters. The sensitized paper will keep for months.

A washed print can be developed after nine months, perhaps longer.

The acid bath should be used at a temperature of between 65° and 75° F.

THE DURABILITY OF TYPEWRITER RIBBONS.

Recently the Department of State desired to know the permanency of the ink and typewriter ribbons for a machine which was to be used for copying the records of the Department of State, and the work was done in the chemical laboratories of the Agricultural Department. The report makes it conclusive that the impression made by the machines from the kinds of ribbons submitted is indestructible. An analysis was made of the ink with a view of determining the nature of the pigments and dyes contained therein, together with the proportion of the oil which forms the basis of the ink. The following results were obtained:

	Per cent.
The volatile matter (water, essential oils for perfuming, etc.)	3·71
Oil	74·51
Blue dye (giving the reactions of methylene blue)	0·93
Prussian blue	13·11
Lampblack (or other form of finely divided carbon)	8·19
Total	100·45

On combustion the ink yielded 9·23 per cent of ash, consisting mainly of ferric oxide, which was nearly equivalent to the percentage of Prussian blue indicated above. The ribbon was placed in a typewriter, and samples of the writing were made on three grades of paper. Portions of these were submitted for seven days to the action of the following reagents: Petroleum ether, alcohol, water, strong chlorine water, a mixture of ether and alcohol, three per cent oxalic acid, ten per cent citric acid, ten per cent hydrochloric acid, ten per cent tartaric acid, and four per cent sodium hydrate. There were no visible signs of action, except that in the case of the chlorine water and sodium hydrate the writing was turned brown, in consequence of the methylene blue and a part of the Prussian blue. It was found that several of the reagents decolorized the ordinary nut gall and iron ink, but in spite of this partial bleaching, the typewriting was readily distinct and readily legible. The carbon of the ink is practically indestructible by reagents which will not destroy the paper, and the oil which forms the basis of the ink carries the finely divided carbon so far into the paper, even when the latter is glazed, that any attempt at erasure necessitates such abrasion of the surface of the paper as is readily detected by a lens, if not with the naked eye.

Prussian blue is a fairly permanent pigment, but yielded more easily to chemical reagents than did the carbon. The blue dye in the sample submitted, which was probably methylene blue, is soluble in alcohol and water, but is protected by the oil which forms so large a percentage of the ink. The only improvement indicated by the tests is the increase of the percentage of the carbon and the decrease of the percentage of Prussian blue. It is undoubtedly true that an ink made of these ingredients in the proportions indicated above will meet every requirement in regard to permanency. It was not thought necessary to extend the analysis to include such minor ingredients as wax, resin, soap, etc., which are added to inks to improve their printing qualities.

THE TUGRIN FOG DISPELLER.

The Monthly Weather Review, published by the Weather Bureau, recently had an account of the Tugrin fog dispeller, which consists of an outlook pipe 8 feet long, the internal diameter being 3 inches. There is a wide flange at the mouth placed so as to be convenient to the navigating officer. A tube enters the pipe from below, and a blower sends a powerful stream of warm air through the tube and the pipe straight ahead, blowing a hole through the fog as it were, which is rolled back in every direction. The moisture is said to condense and flow in rain drops. The navigating officer is enabled to see through the densest fog for several hundred feet. If this blower operates satisfactorily in a horizontal position, it might also do the same in a vertical one, and the region around the blower should, therefore, be well wet by the rain drops that are thus formed out of the fog. It might be an expensive operation, but it would be worth trying on the coast of California, where it is desired to utilize fog.

THE ROWLAND TELEGRAPH SYSTEM.

Prof. Henry A. Rowland gave an exhibition of the workings of his new multiplex telegraphy printer at the meeting of the Johns Hopkins Scientific Association on April 27. The new instrument can be manipulated by anyone who can use the typewriter arrangement by which the messages are sent. The printer will send sixteen messages simultaneously, but eight is the best practical working limit. Prof. Rowland explained the principle of his machine. By shunting off some of the waves of the current, certain letters are stamped on the paper; by shunting off certain other waves, certain other letters are printed. The shunting of the current acts faster than the instrument can work, so that a number of letters can be struck off during one revolution of the instrument. The limit to the number of messages which may be sent at the same time has not been reached.

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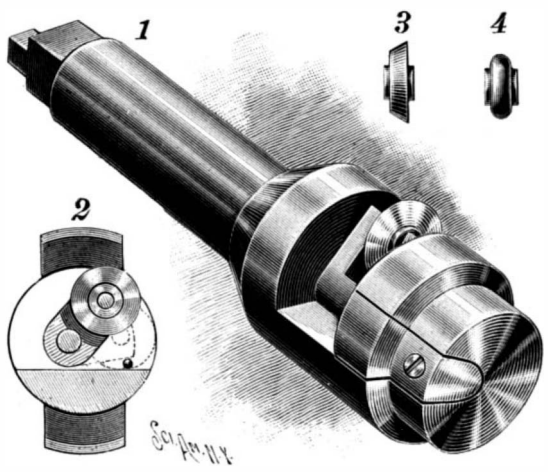
A NOVEL BOILER-TUBE CUTTER AND EXPANDER.

The device illustrated in the accompanying engraving is an apparatus for cutting or expanding boiler-flues, the cutting being performed before the removal of the old flue and the expanding being performed on the new flue to hold it in place.

Fig. 1 is a perspective view of the tool. Fig. 2 is a sectional view showing the eccentric mounting of the expander or cutter. Fig. 3 is a modified form of cutter. Fig. 4 is an edge view of the expander.

The tool consists of a shank and of a body portion. The shank, in the particular form illustrated, is provided with an eccentric passage extending into the body. This passage incloses a rod, the outer end of which projects from the shank and is squared to receive a wrench, and the inner end of which has an arm



HERVEY'S BOILER TUBE CUTTER AND EXPANDER.

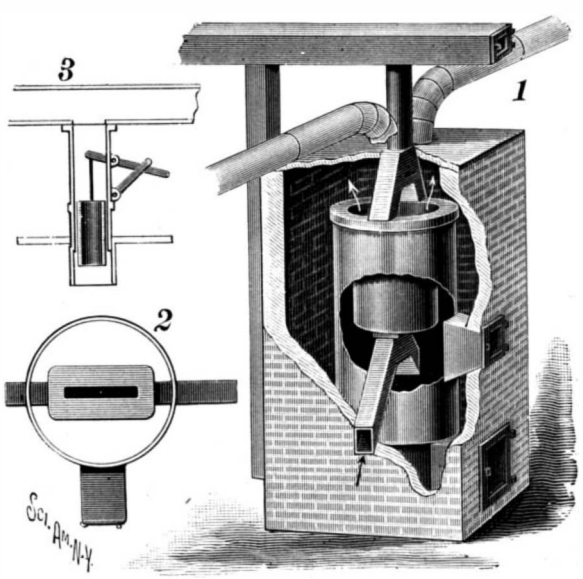
swinging eccentrically in a recess formed in the body. The free ends of this arm are designed to receive a double bevel cutter, or a single bevel cutter, of the form shown in Fig. 3, or an expander of the type illustrated in Fig. 4. In order to permit the insertion and removal of the rod carrying the cutter or expander, the body is formed with a groove which is closed by a removable piece.

In using the tool, the eccentrically-mounted arm is thrown from the position shown in full lines to that shown in dotted lines in Fig. 2, and the body is inserted in the flue. If the flue is to be cut, the eccentric arm is fitted with one of the cutters described; if it is to be expanded, then the arm is fitted with the expander. In order to hold the tool against the flue-sheet a suitable clamping-device is used. In bringing the tool into contact with its work the rod is first turned by means of a wrench, and thus the shank and body are turned to perform the work. The movement of the tool will cause the cutter or expander to engage or bind against the tube and perform its functions. It will be seen that the rotation of the body portion in the flue will force the eccentric arm to the left, as shown in Fig. 2, and that as this movement increases, the cutter enters the flue correspondingly further. The tool, therefore, automatically feeds the cutter or expander as fast as may be desired.

The inventor of the device described is Walter D. Hervey, Chenoa, Ill.

AN IMPROVEMENT IN FURNACE CONSTRUCTION.

The hot-air furnace which we illustrate herewith is so constructed that a large volume of heated air may be obtained from a comparatively small body of fuel,



AN IMPROVEMENT IN FURNACE CONSTRUCTION.

and that the draft may be shut off between the furnace and the chimney or the off-take flue, ample provision being made for the escape of the gases.

Fig. 1 is a perspective view of the furnace, parts being broken away to show the interior arrangement. Fig. 2 is a top plan view of the cold-air flue. Fig. 3 is a vertical section through the off-take and through the valve controlling the draft.

Through the body of the furnace above the grate the cold-air flue is passed, the upper portion of which, as shown in Fig. 2, is slotted. A superheating well, open at the top, and communicating with the slot of the cold-air flue, is located in the upper part of the furnace-body. This well is provided with a flange which is fitted in the upper portion of the furnace, and which has ports connected with a bridge-pipe communicating with an off-take. In the section connecting the bridge-pipe with the off-take a tubular valve is loosely mounted, by means of which valve communication between the off-take and bridge-pipe may be cut off, a sufficient space being left between the valve and the surrounding section to permit the escape of the gases. The means by which the valve is seated consist, as shown in Fig. 3, of a link attached to the valve and pivoted to a lever, locked in adjusted position by a locking-bar.

The furnace is surrounded by a casing of such dimensions that a space is left between the sides of the furnace and the sides of the casing. At the bottom of the casing doors are hung, which ordinarily close openings serving to admit cold air in order to force the column of hot air contained in the upper portion of the casing into the pipes leading to the various rooms of the dwelling.

As the flames and products of combustion must pass around the upper portion of the flue before passing around the superheating well, the cold air admitted is, of necessity, very quickly heated, owing to the heated condition of this portion of the flue. The air thus heated passes into the well, where its temperature is still further raised, and finally enters the supply-pipes.

The inventor of the furnace is Mr. Alexander Heil, of Reading, Pa.

Automobile Regulations in France.

The following regulations for automobile carriages have been made in France. Every type of vehicle employed must offer complete conditions of security as to mechanism, steering gear and brakes. The construction of the carriages must be approved by the Service des Mines. This certificate must be obtained for each type of machine. The builder is then at liberty to manufacture an unlimited number of vehicles. Each vehicle must bear the maker's name, the type of machine and the number of vehicle in that type, as well as the name and address of the owner.

No one may drive the automobile who is not the holder of a certificate of capacity, delivered by the prefect of the department in which he resides and granted with the consent of the Service des Mines. The driver of an automobile must always have the regulator of the speed well in hand. In case of narrow or crowded thoroughfares, the speed must be reduced to a walking pace, and in no case must it exceed 18½ miles in the open country or 12½ miles an hour upon passing houses. Racing is allowed, provided authorization is obtained from the prefect and the mayors are warned. In racing, a speed of thirty kilometers, or 18½ miles, an hour may be exceeded in the open country, but in passing houses the maximum of twenty kilometers (12½ miles) must not be exceeded. The approach of the automobile must be signaled by means of a trumpet. Each automobile must be provided with two lamps, one white and the other green.

A Pneumatic Artificial Limb.

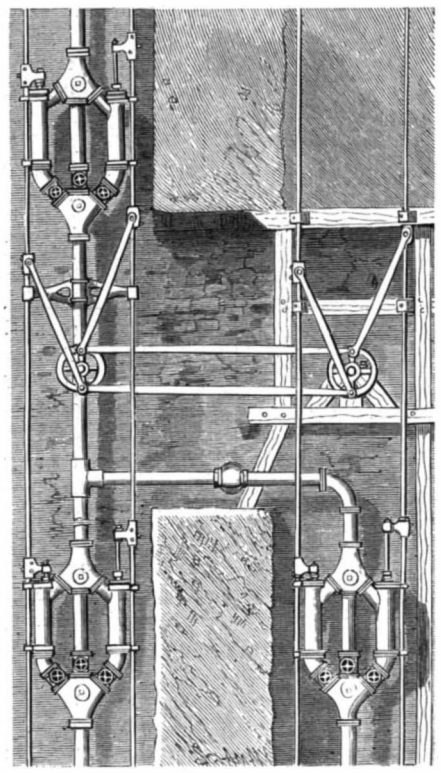
An English inventor has devised a very ingenious artificial leg and foot intended for use in cases of amputation below the knee joint. It is mainly composed of a hollow rubber chamber which is inflated in exactly the same way as is a bicycle tire. The skeleton of the foot is of wood and contains within it a rubber-faced joint which permits of movements like those which take place at the ankle. A pair of rubber pneumatic pads surround the end of the amputated limb, so that no undue pressure is exerted on the tissue.

A DEEP-MINE OR RELAY PUMP.

By means of an improved relay pump, patented by George S. Herbolsheimer, 2343 Bryant Street, Denver, Col., it is possible to pump water out of a mine-shaft at one or more levels simultaneously, the parts of the pump being so arranged that any one of the individual pumps can be connected and disconnected whenever it may be so desired.

The apparatus comprises a series of pumps arranged in pairs at different elevations and connected by a common water-main. Each of the pumps comprises two cylinders having suction and discharge connection with the water-main. In order to render the water-main continuous, a by-pass is employed, which connects the suction and discharge chambers of the pump and which is provided with a cut-off valve. Within the pump-cylinders pistons are fitted, the rods of which are connected with two power-transmitting rods extending alongside of the pumps. The upper ends of the rods are connected with a suitable mechanism for imparting alternate or opposite reciprocations to the rods, so that one piston will ascend while the other descends.

In order to transmit the motion of the rods operating the pumps in a shaft to the rods operating the



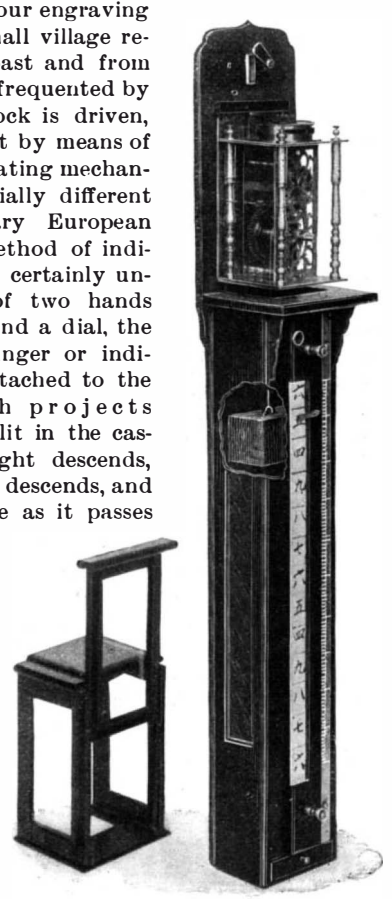
HERBOLSHEIMER'S DEEP-MINE OR RELAY PUMP.

pumps in a sump, links are employed which extend through the level above the sump and join the rods of the two sets of pumps in question, and which are pivoted on crank-wheels connected by pitmen with the power-transmitting rods. The up-and-down motion of the power-transmitting rods of the shaft-pumps is transmitted by the pitmen and link-connected crank-wheels to the power-transmitting rods of the pumps located in the sump, in order to actuate the pistons.

When the cut-off valve in each by-pass is closed, and the cut-off valve in each suction chamber is opened, and when the power-transmitting rods are reciprocated, water is pumped from the mine-shaft, as well as from the level and its sump, to the outside of the mine. By opening the by-pass valve and closing the suction-valves of the proper pump, it is possible to cut out a level or main shaft, as desired, so that water is removed only from the main shaft or from the level.

A QUAINT OLD JAPANESE CLOCK.

Mr. and Mrs. Joseph Wintherbotham, of Chicago, in their travels in Japan, last year, came across the clock from which our engraving was made, in a small village remote from the coast and from the cities usually frequented by travelers. The clock is driven, not by springs, but by means of a weight. Its operating mechanism is not essentially different from the ordinary European clock; but the method of indicating the time is certainly unusual. Instead of two hands which travel around a dial, the clock employs a finger or indicator, which is attached to the weight and which projects through a long slit in the casing. As the weight descends, the finger likewise descends, and indicates the time as it passes over a vertical scale on which the divisions of time are inscribed in Japanese characters. These divisions are subdivided by means of an auxiliary scale, over which the indicator also travels. Apart from this curious method of indicating the time of day, the clock is remarkable for its excellent workmanship. Its beautiful ebony case, its well-cut gear wheels, and its polished brass frame, coupled with its queer elongated form and unclock-like appearance, lend to it an interest which we hardly attach to our ordinary time-pieces. This curious old Japanese clock may be seen at the office of this paper.



A QUAINT OLD JAPANESE CLOCK.

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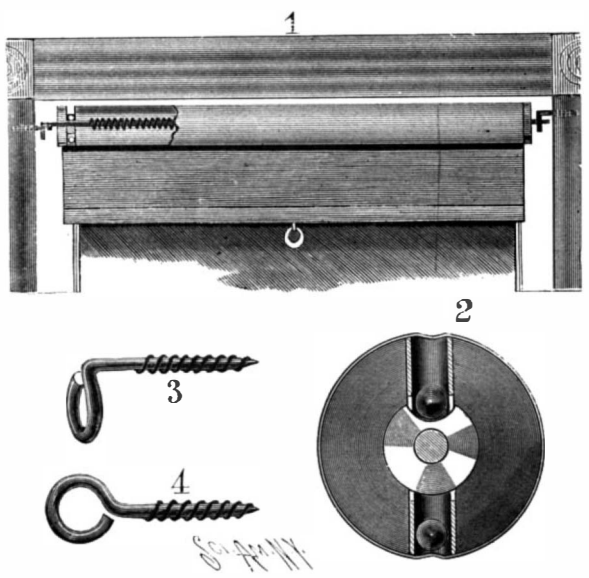
A NEW SHADE-ROLLER ATTACHMENT.

A patent has been granted to Herbert W. Mower, of 98 Cutler Street, Newark, N. J., for a shade-roller which is so constructed that it may be hung either from the upper portion of a window-frame or from the sides, and which is provided with a novel, positively-acting brake for the spring-controlled trunnion.

Fig. 1 is a front elevation of the upper portion of a window-frame, showing the roller in position. Fig. 2 is a cross-section of the roller. Figs. 3 and 4 are perspective views of brackets for hanging the roller.

The roller consists of a metal tube provided at one end with a fixed trunnion, and at the opposite end with a spring-controlled trunnion, bent at an angle to its body to form a pendent bearing. A transverse tube is secured in the roller near the pendent bearing of the spring-controlled trunnion, by indenting a portion of the metal of the roller into the ends of the tube. At its center the tube is longitudinally slotted to receive a



MOWER'S SHADE-ROLLER ATTACHMENT.

disk which is firmly attached to the spring-controlled trunnion. The disk is provided with a recess to receive balls, one of which is located in each end portion of the transverse tube, as shown in Fig. 2. When a ball enters the recess, the disk is prevented from turning until the ball has been dislodged.

The shade is secured to the roller by springs passed at one end through apertures in the shade and through corresponding apertures in the shade-roller, the other end of the spring engaging with the outer surface of the roller.

The hangers, as illustrated in Figs. 3 and 4, are screw-eyes. The eye of one of the hangers is in alinement with the screw-shank; but the eye of the other hanger is at a right angle to its screw-shank.

These hangers enable a shade to be hung from the upper portion of a window-frame or from the sides, and permit a roller to be fitted to a window-frame in which an ordinary roller of the same length could not be hung. The pendent bearing of the spring-controlled trunnion passes through the bent eye; while the fixed trunnion enters the straight eye.

A RAPID WAY OF MARKING OUT CLOTH PATTERNS.

The marking out of cloth by machinery, although it has engaged the attention of many an inventive mind, has not kept abreast with the development of other branches of the clothing and tailoring trades. The particular form of marking out which has attracted most garment cutters is a method in which stencils or perforated "lays," as they are technically known, are employed. Most attempts in this direction have failed because the material for the lays was unsuitable; because the perforations were imperfect; and because there was no satisfactory way of fixing the pattern upon the cloth to be cut.

These defects have been overcome in a method which although originally patented in part in the United States, up to the present time has found its greatest application in Great Britain and in France. The method in question is employed in connection with a patent process marker, and is the invention of Mr. James Marsden, of Wigan, England, a large clothing manufacturer.

The material used for the lays is a durable and inexpensive fabric, the meshes of which are closed by a filling insuring the production of sharply cut perforations. Upon this filled fabric a skilled designer plans and marks out the various patterns ("lays"). After having been thus marked out, the filled cloth is ready to be perforated on the lines of the pattern.

The machine used for this purpose differs in no essential from the usual sewing-machine, except that the needle-bar, instead of holding the usual needle, carries a punch, fitting accurately one of a series of holes formed in a disk sunk flush with the machine-table. These holes are conical in shape; and the end of the punch is similarly formed. By reason of this construction the punch is cleaned at each stroke, and the minute portions of cloth removed drop into a receptacle below the machine-table. The holes are circularly arranged in the disk for reasons of economy; for when a hole has been worn out, another can be swung into place by rotating the disk through the proper distance. In size these holes vary from a perforation so exceedingly fine as to be hardly perceptible to an opening equal to the diameter of a pipestem hole. This perforated disk insures the production of sharply cut perforations and the cleaning of the punch. It is by means of this modified sewing-machine that the marked-out cloth is pierced to form the stencil-like lay.

In order to mark out the cloth to be cut, a glutinous powder is used which is rubbed over the lay, so that an imprint is left on the cloth wherever the powder has passed through the perforations. In order to fix these marks a hot roller machine provided with an automatic folder is used, whereby the powder marks are fixed by the action of the heat on the glutinous ingredients. Thus fixed, the marks cannot be rubbed out during the process of machine cutting. For hand cutting or for linen, cotton and close-grained fabrics, this heating process can be dispensed with.

A lay once made can be used over and over again. It corresponds in effect with the type of a printing press, from which as many prints can be made as may be desired. Not the least remarkable feature of the whole process is the great rapidity with which patterns can be reproduced. A lay which originally required one hour's work of a skilled cutter can be reproduced by means of the process more than twenty times within the same period. The process marker has been applied to every branch of the clothing trades, even to "custom tailoring."

The Excavation of Babylon.

German archæologists are busy with plans for the excavation of Babylon. The late Sir Austen Henry Layard, the explorer of Nineveh, was the first one to do anything in the way of excavating Babylon, then Sir Henry Rawlinson followed. The excavations, it is claimed by the Germans, were done in a half-hearted way, and they are determined that their work shall be thorough. It will be very costly, and it is estimated it will occupy five years. It will be carried on by the Orient Society jointly with the Directors of the Royal German Museum and the leader of the expedition is Dr. Robert Koldewey, who has already had much experience in such work. The expeditions will start from Beirut, going from there to Aleppo, whence they will travel by caravan to Bagdad. Babylon itself is two days' journey from Bagdad, and consists of rough mounds scattered on the banks of the Euphrates, under which lie the ruins of a great city. The excavators will begin with the fortress which is what remains of Nebuchadnezzar's palace, where Alexander died. In addition to their excavating upon the city site proper they will investigate a number of other ruins situated near.

A DEVICE FOR REMOVING DENTS FROM GUN-BARRELS.

In order to provide a means for removing the dents or depressions from gun-barrels, Henry H. Hotz, of Cuero, Tex., has invented a simple device which, by means of an expander-rod and expanding-tube, forces the indented portions outwardly.

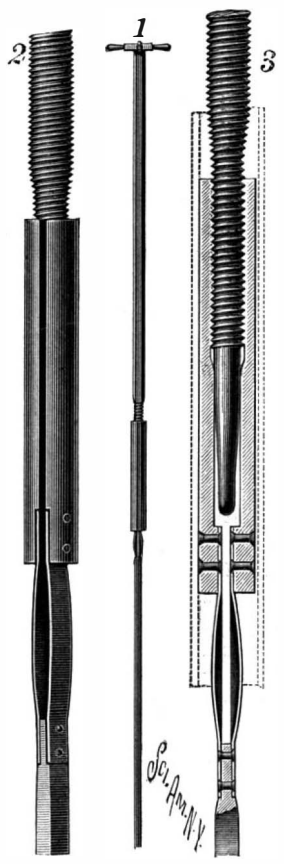


Fig. 1 shows the expander-rod and expanding-tube screwed together. Fig. 2 is a perspective view showing part of the device. Fig. 3 is a longitudinal section through a gun-barrel with the device in operative position, the gun-barrel being shown in dotted lines.

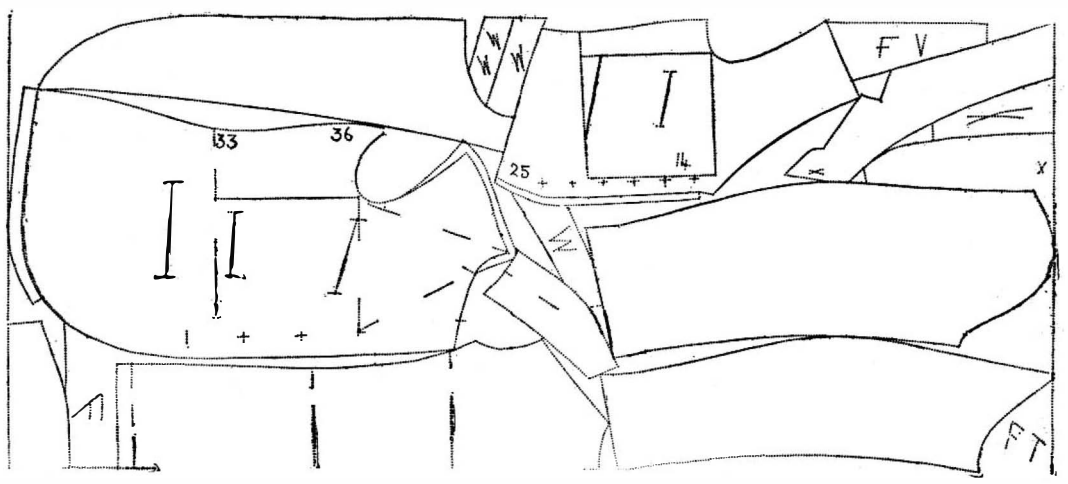
The expanding-tube is constructed in semicylindrical sections which are provided at their upper ends with a threaded bore communicating with a reduced smooth bore, and which are connected by two spring sections secured to a handle.

The expander-rod at its upper end is provided with an operating-handle. The lower end of the expander-rod terminates in a conical tip, surmounted by a reduced plain surface, above which a threaded surface is formed.

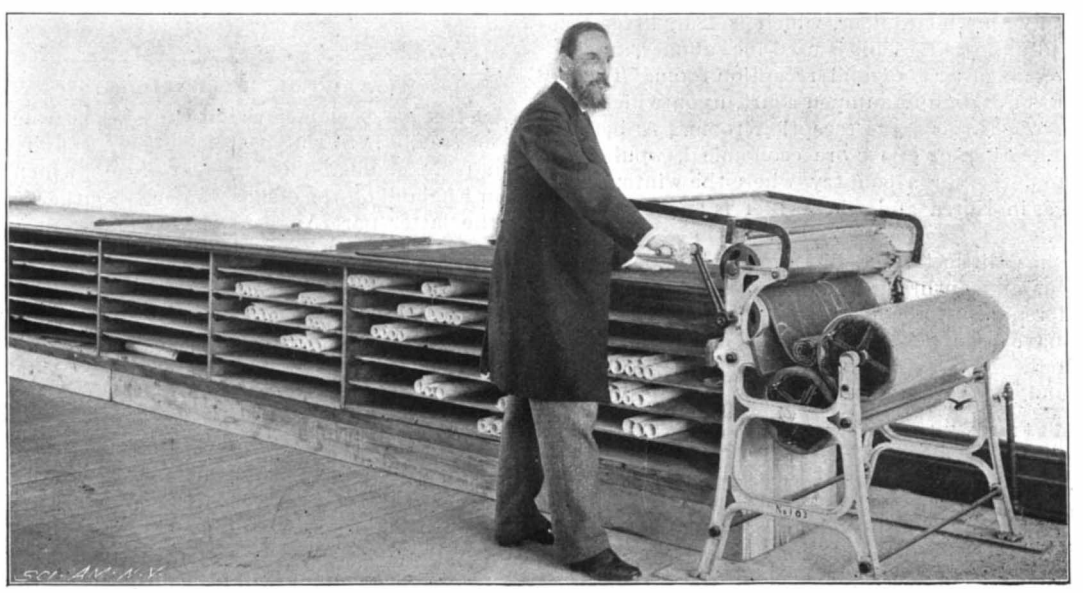
In operation the expanding-tube is inserted in the gun-barrel with the semicylindrical sections opposite the indentations to be removed. The expander-rod is then entered at the opposite end of the barrel; and the tip of the rod is inserted in the tube until the threaded surface of the rod engages the threaded bore of the tube. By turning the operating-handle, the expander-rod is screwed into the threaded bore of the tube, thus causing the reduced plain surface of the rod to engage the smooth bore of the tube and force it outwardly against the depressed portions of the barrel.

The device can be employed to remove the indentations in organ-pipes and other tubes as well as from gun-barrels.

A MEMBER of the faculty of a Western university has announced that he has succeeded in very materially reducing the cost of lithium. The full details of the method have not been disclosed, but electricity is the method by which the metal is separated.



A PERFORATED LAY.



FIXING THE PATTERN-MARKS UPON THE CLOTH.

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Pet Animals as Causes of Disease.

Papers presented last summer at the French Congress for Tuberculosis at Paris demonstrate, says The Medical News, what has hitherto been very doubtful, that aviary and human tuberculosis are essentially the same pathologic process due to the same germ modified by a cultural environment, but convertible under favorable circumstances one into the other. An Englishman has found that more than ten per cent of canaries and other song birds that die in captivity succumb to tuberculosis, and parrots have come in for a share of condemnation in this connection. By far the larger number of monkeys who die in captivity are carried off by tuberculosis, and while, fortunately, the keeping of monkeys as house pets is not very general, at the same time there is some danger of contagion. Nocard, the greatest living authority on tuberculosis in animals, and the man to whom we owe the best culture methods for the tubercle bacillus, found in a series of autopsies on dogs that out of 200 successive autopsies on unselected dogs that died at the great veterinary school at Alfort, near Paris, in more than one-half the cases there were tubercular lesions, and in many of them the lesions were of such a character as to make them facile and plenteous disseminators of infective tuberculous materials.

Parrots are known to be susceptible to a disease peculiar to themselves, and a number of fatal cases in human beings of what was at first supposed to be malignant influenza pneumonia was traced to the bacillus which is thought to be the cause of the parrot disease. Cats are known to sometimes have tuberculosis, and that they have in many cases been carriers of diphtheria and other ordinary infections is more than suspected. There is not at present any great need for a crusade on sanitary grounds against the keeping of pet animals, but they are multiplying more and more, and it does not seem unreasonable that greater care in the matter of determining the first signs of disease should be demanded of their owners, and then so guarding them as to prevent their being a source of contagion to human beings. Attention should be paid to this warning as regards children, as animals play more freely with them and the children are more apt to be infected.

Stoves and Methods of Heating in Korea.

In reply to numerous inquiries from manufacturers of stoves in the United States as to the prospects of extending their business to Korea, I wish, says Mr. Horace N. Allen, Consul-General, to make answer in this general manner.

Stoves are not used to any extent by the native Koreans. The Korean method of heating is most excellently adapted to their resources and conditions. In building their houses they lay down a system of flues where the floor is to be. These flues begin at a fireplace, which is usually placed in an outer shed or connecting closed alleyway. From this fireplace the flues extend in a more or less curved direction, like the ribs of a round fan, to a trench at the rear of the room, which in turn opens into a chimney, which is usually placed some distance from the house. Flat flagstones are then placed carefully over these flues, and the whole is cemented over and finally covered with the thick oil paper for which the country is noted. This paper keeps smoke from entering the room, and a little straw or brushwood, used in the fireplace for cooking the rice, serves to heat the stone floor and gives an agreeable warmth which lasts till the time of the next meal. Two heatings daily serve to give the people a nice warm floor, upon which they sit in the daytime and sleep at night. By leaving their shoes at the door the inmates preserve the paper floor, which, from constant polishing, takes on a rich brown color.

Among the poor these rooms are cubes of eight feet, but in more pretentious houses there will be a suite of four of these rooms opening into each other by sliding doors and capable of being thrown into one large room. A suite of these rooms on either side opens upon a large room with a board floor, which is 18 by 18 feet or larger, and unheated. This is used for summer, and at all times as an outer hall and reception room. These houses are built around an open court, upon which, at the back, opens this large reception room. A better system of heating, or one more economical, would be difficult to devise for a country where the winters are so severe as in Korea and where fuel is so scarce and expensive.

Korea has little timber, but excellent deposits of bituminous and anthracite coal, especially the latter. So far all requests for concessions to mine these coal deposits have been positively refused by the Korean government. Natives dig out the surface coal in the crudest and most expensive manner, allowing the debris and water from the heavy rains to fill up the shaft or hole and damage the coal to be got out the following year. The result is that the coal finally offered for sale is so rotten from exposure to wet and cold that, after it has been frequently handled and packed on pony back, it arrives in Seoul mostly in the condition of fine dust, which has to be mixed with wet, red clay and made into balls by hand. These balls, when dry, are used by the foreigners in their stoves. This poor stuff is exceedingly expensive, costing this year 18 yen ($9) per ton, from which must be taken the included weight of some fourteen or sixteen heavy straw bags in which the coal arrives.

The few hundred foreigners in Korea (Americans and Europeans) use stoves, as the paper floors do not answer for foreign use, owing to the fact that our rooms are too large and our shoes and furniture soon ruin the floors. Stoves from Germany at one time were quite in favor, but the stove most commonly used now is one made at Dowagiac, Mich. Even a few Koreans have begun to employ them.

Owing to the high price of coal, numbers of kerosene stoves are now being used, and these seem to appeal to the Koreans, as they are neat and handy and furnish light as well as heat.

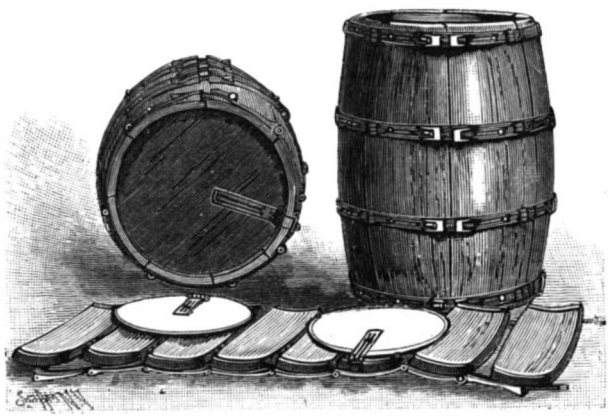
There can never, however, be a large trade in heating stoves in Korea so long as the people adhere to their present style of houses.

A KNOCKDOWN CASK.

In certain branches of business, especially in the transportation of beer from place to place, it is a matter of no little expense to return the empty casks. This expense might be greatly reduced by the use of a simple knockdown cask, which when collapsed would take up but a small portion of the space usually required. Such a cask has been invented by Phillis Mayotte, of Escanaba, Mich.

From the annexed illustration it will be observed that the staves and the top and bottom heads of the cask differ in no essential from those ordinarily employed. The hoops, however, are composed, not of iron bands, but of chains, the end links of which are held together by tightening-bolts. Pins are secured in the staves, which enter slots in the links, thus permitting a slight circumferential movement of the links, while holding the chain to the staves.

When it is desired to return an empty cask, the



MAYOTTE'S KNOCKDOWN CASK.

chains are loosened by unscrewing the tightening-bolts, whereupon the staves may be laid out flat, and the heads removed. A number of casks which have been thus collapsed may be packed in the space which would otherwise be required for one cask.

Rescue by the Aid of Wireless Telegraphy.

The Marconi system of wireless telegraphy proved very serviceable on April 28, when the "Goodwin Sands" lightship was run into by the British steamer "R. F. Matthews." The lightship was provided with a wireless telegraphy apparatus, and by it the crew was able to notify the station at South Foreland that their vessel was sinking. The message was transmitted to Margate, and tugs were at once dispatched to the lightship. Marconi's assistant was in the lighthouse at South Foreland, twelve miles away from the lightship. He was startled at hearing the alarm bell ring, and immediately replied to the signal. He forwarded the message at once with the aid of the ordinary telegraph.

Antarctic Explorations.

A letter has been received at Christiania from Capt. Borchgrevink. It will be remembered that the captain is in command of the expedition which sailed from England on the steam whaler "Southern Cross" in the latter part August, 1898, to make an exploration of the Antarctic continent. It is dated from Cape Adair, Victoria Land, February 28. It states that he had landed on the great Antarctic continent with his staff, instruments, and seventy-five dogs.

A Cable to Germany.

New York city is to be the terminus of a new transatlantic cable which will connect the United States and Germany. When it is laid, the new cable will be the first ever constructed between Germany and the United States. The German terminus will be at Ems, Prussia, and the route as now planned will be by way of the Azores. The company will be called the German-Atlantic Telegraph Company.

Science Notes.

After the "Britomart" is launched, Liverpool will see the last launch which will be made within the city limits. Seven miles of shore is now under the control of the Dock Board, which has set to work on the scheme of reconstructing the docks authorized by Parliament.

St. Lothaire, in the Jura Mountains, has erected a monument to Charles Marc Sauria, a country doctor who, in 1831, invented the lucifer match. Unfortunately, he was too poor to patent his invention and reap his reward. There are, however, Austrian and Hungarian claimants to priority in this invention.

Old Ben Bush, the giant half-breed Indian, was recently burned in his cabin at his New Jersey home. It is believed that the cabin blew down and was set on fire by the burning logs on the hearth. He was one of the most noted of the many strange characters of the wild SourLand Mountain district in the western part of Somerset County. He was seven feet in height and was straight and agile as many of the young mountaineers, notwithstanding the fact that he was a centenarian.

Prof. Angelo Heilprin, of the Philadelphia Academy of Sciences, has just completed his calculations of the heights of the five principal volcanic mountain peaks in Mexico. The results of his measurements are as follows: Orizaba, as measured by the Delcros tables, 18,206 feet; Popocatepetl, 17,523 feet; Izraccihuatl, 16,960 feet; Nevada de Toluca, 14,954 feet. It has long been said that Popocatepetl was the highest mountain peak in Mexico. Baron von Humboldt's measurement of Orizaba peak was 17,375 feet.

H. le Chatelier gives in the Comptes Rendus tables showing the increase of resistance of steel after tempering at various temperatures ranging from 710° to 1,100°. The samples tested consisted of two pieces of ordinary steel, four of tungsten steel, and three of chrome steel. At a high temperature chromium adds to the increase of resistance due to the carbon alone; tungsten, on the other hand, diminishes it. In all cases the resistance increases with the increase of temperature up to a limiting value depending upon the constitution of the steel.

A correspondent living in the State of New Jersey wrote us some time ago asking for information relative to a proper substitute for leather. He stated that he was a vegetarian and wished to supply all his needs without the necessity of killing any innocent creature. He said: "I found out how to satisfy my needs inside of the vegetable kingdom and desire to supply the outside needs from the same source, where it can be done easily, and by little extra effort. Perhaps you may not know that there is one farm in the State of New Jersey which does not raise animals to kill and eat. There are ten of us on this farm. We find in grains, fruits, vegetables, and nuts a substance giving greater health and better strength physically and mentally than when we formerly dined on flesh years ago. We are endeavoring to enlighten the minds of people hereabout on this subject, in the hope that they may be induced to go and do likewise some day, and thereby be free from the diseases which inflict many of them by reason of indulging in chewing the bodies of their fellow creatures." This letter is dated "From the Lord's Farm."

A new system of cross road post offices has been devised by a Virginian inventor. The idea is to form an adjunct to the suburban system now being developed for the relief of the country residents. All who have lived in the country where there is no free rural delivery know the trouble it is to drive two or three miles to the post office to get mail. In the new system a large mail box is arranged at cross roads or any other convenient locality, and the box is divided by a number of partitions into small individual post boxes, which are adapted to receive mail. The carrier drives along the main road in a wagon, opens the front of the box, which falls in a horizontal position and acts as a shelf. A number of small individual boxes are revealed; the postman can swing out the whole front of the box containing the small windows and locks, and can then put the mail in the various boxes. When he finishes his task, the front is swung to again and locked and the mail is shielded so that a resident can only obtain the mail in his particular box. When the resident wishes to obtain his mail, all he has to do is to unlock the outer door, which swings down again, revealing the front with the rows of boxes. He then opens his individual box, takes out the mail, closes and locks it and swings the front again into place. Facilities are also provided in the new system for stamping mail, so that letters collected at one point on the route can be delivered to another point without carrying them to some main office for cancelation and stamping. A large space is reserved in the bottom as a repository for mail matter that is dropped in the usual way, through a slot. The patent contemplates the combination of an electrical system by which the box owners may be notified at their homes when mail has been placed in their individual boxes.

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Correspondence.

A Letter from Mr. Hiram S. Maxim.

To the Editor of the SCIENTIFIC AMERICAN:

I have repeatedly seen letters in the SCIENTIFIC AMERICAN, New York Herald, and other journals signed "Hudson Maxim," in which he claims to have worked with me in the early development of smokeless powder.

These statements are misleading in the extreme, because as a matter of fact Hudson Maxim had nothing whatsoever to do with the early development of smokeless powder in England. That type of powder consisting of pure guncotton was developed by the French. Nobel developed a successful smokeless powder by combining soluble collodion cotton with nitroglycerine, while I was the first to make a smokeless powder consisting of nitroglycerine and true guncotton. I was the first to make this powder, the first to patent it, and the first to use it. I was also the first to combine oils, paraffines, etc., with smokeless powder to prevent detonation. I had two assistants, Mr. Edmund Ryves and Mr. Brewer. Hudson Maxim did not assist with the experiments and had nothing whatsoever to do in the invention or development of this powder. An examination of the patents will show who the patentee really was.

My first patent on smokeless powder is dated November 8, 1888.

In regard to the nitroglycerine patent, I will only quote one and two of my English patent, March 14, 1889:

"First.—An explosive compound, consisting essentially of guncotton or pyroxyline mixed with nitroglycerine, nitrogelatine or similar material, and with castor oil or other suitable oil, for the purpose above specified.

"Second.—The manufacture of an explosive compound, by first dissolving guncotton by means of acetone or other solvent, and then incorporating with the dissolved guncotton, nitroglycerine, nitrogelatine or similar material, and castor oil or other suitable oil, substantially as hereinbefore described."

HIRAM STEVENS MAXIM.

London, April 19, 1899.

THE 10-INCH GUN EXPLOSION AT SANDY HOOK.

To the Editor of the SCIENTIFIC AMERICAN:

I notice in the SCIENTIFIC AMERICAN of April 8, 1899, an account of the explosion of a 10-inch army gun at Sandy Hook.* I have also read the letter on the same subject by Hudson Maxim, in which he attempts to account for the explosion and at the same time suggests a remedy which he believes will, if adopted, avert further disaster.

Mr. Hudson Maxim attributes the disaster to the charge being driven forward into the narrow neck by the pressure, where the grains of powder were jammed together, and an exaggerated illustration is shown with the grains of powder driven forward and jamming in the neck of the chamber. Now, as a matter of fact, in all large guns of modern make, the chamber is very little larger than the bore, the chamber not being bottle-necked to any considerable extent. Mr. Hudson Maxim proposes as a remedy that long bars or sticks of powder should be employed extending the entire length of the chamber, and that these sticks should be transversely perforated. Had the artillerists of the world, who have been experimenting during the last eight years with smokeless powders, exchanged the results of such experiments, it would have saved a great deal of trouble and prevented a considerable loss of life. This multiple-perforated smokeless powder was tried in my presence over two years ago. At that time I had charge of the proof range of the Maxim-Nordenfelt Guns and Ammunition Company, at Swanley, Kent. Hudson Maxim, who had been in England for some time, had much to say about a multiple-perforated powder, and it was understood that as soon as this powder arrived from America it was to be tested by the company, but it never came. Various reasons were assigned why it had been delayed, and it was not until after Mr. Spencer D. Schuyler (who had furnished the money in the States for carrying on the experiments) arrived in England that we learned the truth. Mr. Schuyler reported that they had found it impossible to make powder which would stand the heat test required in England. However, in the meantime we obtained some large Chilworth cords and Mr. Hiram S. Maxim made a machine for transversely perforating them in accordance with Hudson Maxim's patent. When large cords were transversely perforated, it was found that, with three-quarter charges, they produced identical results with small cords unperforated, so that there was absolutely no advantage in the perforations; but when the powder was heated say to 100° and fired, or when charges sufficiently large were employed to produce service velocities, then the action of the powder became very erratic; in fact, a slight addition to a charge which had produced a comparatively low pressure produced an enormously high and dangerous pressure. The effect of heat was also most marked, the large sticks of multiple-perforated powder being much more affected by heat than the small non-perforated sticks. We therefore found that multiple perforations, instead of being an advantage, were a great disadvantage; in fact, they not only gave very unsteady or uneven results, but were also extremely dangerous, especially when the charge was large enough to produce service velocities. Had this information been communicated to the authorities in America, I feel sure that it would have prevented the recent disastrous explosion by which one officer was killed, two men wounded, and a large amount of property destroyed.

Now, in regard to the packing or jamming of the powder in the bottle neck of the chamber, this is absolutely impossible. If two sticks of powder are placed in contact and lighted, the evolution of gas from their surfaces is such as to blow them apart. When a large gun is loaded with smokeless powder, the bundle of powder does not by any means fill the chamber. In a 10-inch gun there is at least 3 inches space above the powder charge. Besides, there is a passageway for the gases to pass between the sticks or grains. When the charge is ignited, the gases, by having a very much lower specific gravity and, consequently, less inertia than the powder, are the first to rush forward and produce a pressure at the base of the projectile. Suppose, for the sake of argument, that the powder should be pressed together in the chamber, it would instantly be thrown back again, because the nearer the powder is together, the higher the pressure and the faster it burns. I show herewith in diagrams the approximate position of the powder in the case before firing, Fig. 1, and after firing, Fig. 2. It will be observed that before the charge is fired all the sticks are in contact in the lower part of the chamber. When, however, the charge is ignited, the very powerful current of gas being evolved from the entire surface of all the powder and blowing outward with great force separates the sticks, and they instantly arrange themselves in the powder chamber so that none of them touch; that is, they automatically space themselves. It will be seen, with a moment's consideration, that this must necessarily be the case. No amount of pressure will bring two burning pieces of powder into actual contact. The pressure will always mount and the velocity of burning increase just in proportion to the degree of pressure applied. Contact is, therefore, rendered impossible. The fact is that 100 tons pressure to the square inch would not force two pieces of burning powder together.

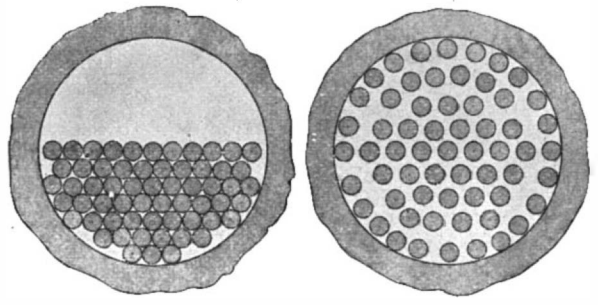

FIG. 1. FIG. 2.

FIG. 1.—Approximate position of the powder in the gun before ignition.

FIG. 2.—Approximate position of the sticks of powder in the gun after firing. Sticks are nearly full length of powder chamber.

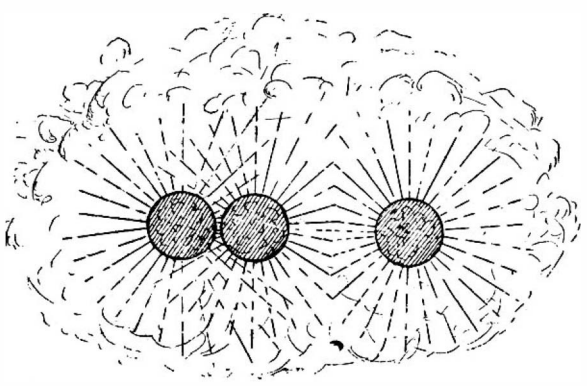

FIG. 3.—Shows middle stick placed nearer the left stick. Evolution of gas would move middle stick to position equidistant between the other two.

I have thought that the American public must be very much puzzled in regard to the early history of smokeless powder and as to who the inventor really was. I have seen several articles—some in the SCIENTIFIC AMERICAN—written by Hudson Maxim, in one of which he speaks of the experiments in England, which were really made by his brother, in such a manner as to lead the public to believe that he assisted in these experiments and was a joint inventor. In referring to these experiments, he uses such expressions as "we did this," "we did that," etc. In a word, he claims to have been Mr. Hiram S. Maxim's collaborator and to have assisted in evolving the first smokeless powder composed of nitroglycerine and guncotton. I can say, however, from my own personal experience, that the facts of the case are as follows:

Mr. Hiram S. Maxim first commenced his experiments at the little laboratory at his own house with his coachman as his assistant. At the end of the first week, having graduated from college and from a technical school, I was employed by Mr. Maxim as his assistant, and I have remained with the firm ever since. Hudson Maxim took no part whatsoever in the experiments and had nothing to do with the invention or development of the powder. Mr. Hiram S. Maxim commenced his experiments with a view of finding out the effect of different kinds of grease and vaseline upon highly explosive compounds. The first smokeless powder made by us was a pure tri-nitrocellulose. This not keeping well, on account of its getting too dry, 2 per cent of castor oil was added. This produced a powder which was fully equal to the French and with excellent keeping qualities. We then commenced a series of experiments by adding nitroglycerine, and we used every possible mixture from 1 per cent to 80 per cent. Those having over 50 per cent of nitroglycerine were believed to be unsafe; so we finally reduced the percentage of nitroglycerine, partially on account of the prejudice against it, until we left it at about 15 per cent. In nearly all cases we employed 2 per cent of castor oil, and this was found to prevent detonation.

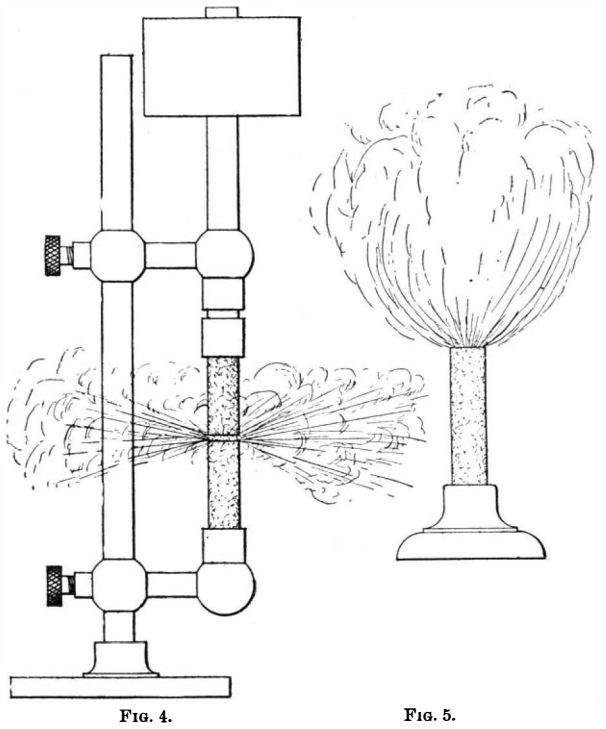

FIG. 4. FIG. 5.

FIG. 4.—Two sticks of powder mounted end to end, pressed together and ignited, as shown, will burn with a great rapidity proportional to the pressure.

FIG. 5.—Stick of smokeless powder, ½ inch in diameter, set in stand and burning from one end at rate of 1 inch in seven seconds.

There are few men living who have fired more rounds of ammunition than myself, and from my experience I should say that the cause of the explosion at Sandy Hook was due to one or all of three things, namely:

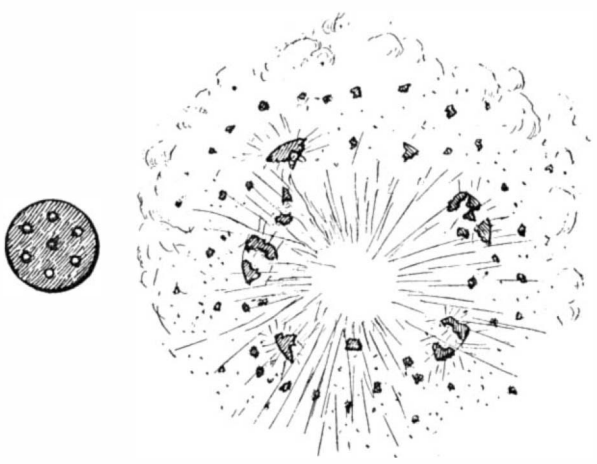

FIG. 6.—Perforated powder before and after explosion.

1. The leaving out of the castor oil or vaseline from the mixture.
2. The addition of a considerable quantity of unstable di-nitrocellulose to the compound to make it hard.
3. The multiple perforations.

London, April 18, 1899. EDMUND J. RYVES.

THE North Dakota Senate has passed a bill requiring all applicants for marriage licenses to be previously examined by a board of physicians as to their mental and physical fitness for the marriage state. The certificates must show that they are free from hereditary diseases, with special reference to insanity and tuberculosis. The idea is to insure that the children born of future marriages shall be sound both mentally and physically. Legislation of this kind is interesting, but that is about all that can be said for it, for there is nothing to hinder the contracting parties from going over the border into adjoining States to have the ceremony performed.

*A further discussion of the explosion will be found in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT.

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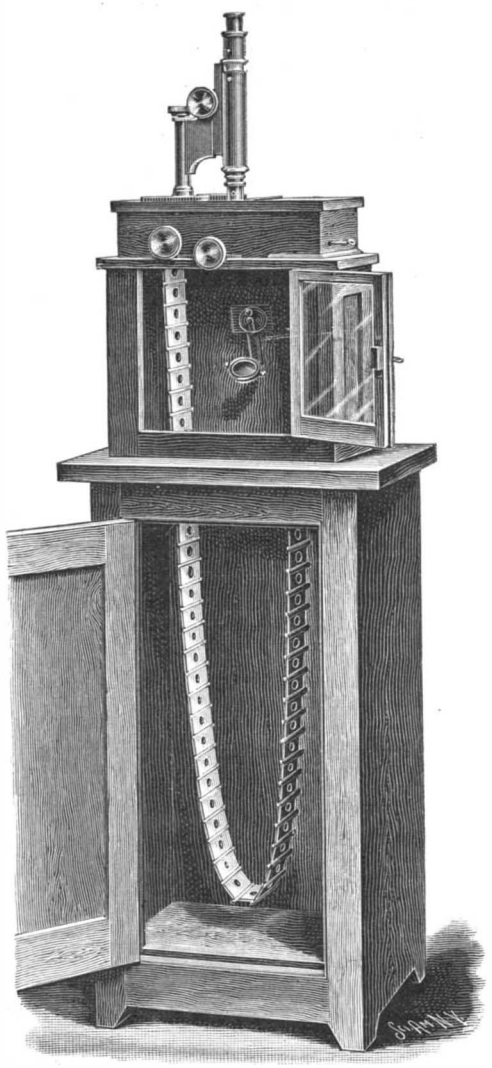
THE CLASS MICROSCOPE.

The question of the exhibition of microscopic objects to classes and the general public is an interesting and important one, and the subject appears to have been thoroughly examined by Dr. James M. Flint, U. S. N., one of the Curators of the Smithsonian Institution, who has given the results of his studies in the Report of the National Museum for 1896. He has devised several plans for exhibiting microscopical objects not requiring the use of very high magnifying powers. The instrument shown in our first engraving is in use in the National Museum, and it was made in



MICROSCOPE FOR EXHIBITING ORDINARY MOUNTED OBJECTS.

the year 1890 and has been modified in a few details since, and has successfully endured manipulation by thousands of inexpert hands—of children as well as adults—without injury, and this without attention or supervision of any kind.

The instrument was devised for the special purpose of exhibiting to the public a series of foraminifera—minute marine shells. These shells are mounted on concave brass disks having short stems which may be inserted in holes in the rotary stage. There are five concentric rows of holes in the stage, which is 15 inches in diameter, allowing the exhibition of two hundred and forty-two separate mounts. Illumination is increased by the use of a parabolic reflector adjustable beneath the plate glass cover of the box, just clear of the mounts. The stage is rotated by means of a friction roller placed beneath the stage and controlled by the milled head represented at the left in the illustration. The other milled head operates a slide upon which the stage is pivoted by means of a rack and pinion. The objective in actual use is a 2-inch, that being found sufficient for the purpose and more easily manipulated by the laity than one of high power. Much higher powers might be used, however, the only limit being a sufficient working distance to allow the mounted objects to pass freely under the objective. For the exhibition of translucent objects the only modifications of the instrument necessary would be the enlargement of the perforations in the rotary stage, the mounting of the objects upon small squares or circles of glass, and the adjustment of a mirror beneath the stage.

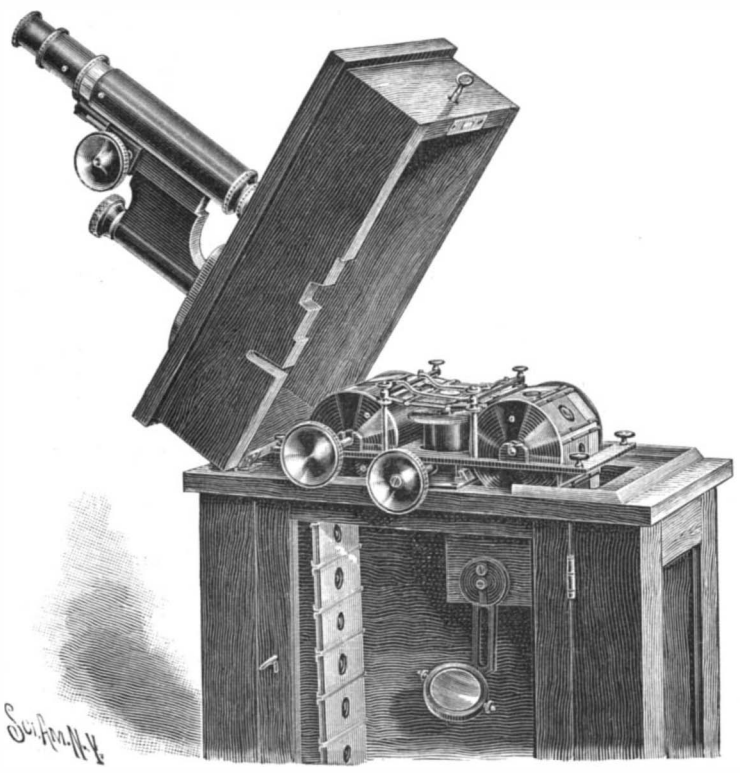
For the purpose of exhibiting a series of preparations mounted in the usual way upon glass slips, or slides, an entirely different form of apparatus has been devised. An indefinite number of slides from ten to a hundred are attached to an endless band of linen by means of thin brass holders which allow the slides to be changed when desired. This linen band passes over two rollers mounted upon a light brass frame which occupies the place of the stage of an ordinary microscope; the loop of the band carrying the slides hangs free. One of the rollers has a projecting pivot with a milled head, by which it may be rotated, and the two rollers are connected by a narrow belt at each end. As the rollers are made to revolve, the band carrying the slides passes horizontally under the microscope they rest upon the two narrow belts and are kept at a definite distance from the objective of the microscope by means of two guides which press upon the slides from above. The brass frame rests upon a grooved bed-plate, which permits of a lateral movement of the frame. This lateral motion is controlled by a screw operating by a second milled head in convenient proximity to the one giving a to-and-fro motion. As in the other instruments, the specimens, and nearly all the parts of the mechanism, are inclosed in a box secured by a lock, the only exposed parts being the microscope and the two milled heads controlling the motion of the slides. The advantages of this form of the apparatus are that the usual glass slides as used by microscopists, which are three inches long by one inch wide, upon which microscopic objects are usually mounted, may be used, and specially that the focal distance is not disturbed by difference in thickness of the glass slides.

It will be noticed that there is a glass door at the upper part of the case which allows the light to pass to a mirror which reflects the light upward exactly as with the ordinary microscope stand. The usual rotary diaphragm is placed between the rollers which carry the band. It may be worth while to mention a device to prevent injury to the instrument from violent twisting of the milled head which controls the lateral movement of the frame after the frame has brought up against the stages in either direction. This is effected by slightly tapering the pivot of the screw governing the movement and attaching the head by friction only, the amount of friction being regulated by a set-screw in the end, so that before a dangerous strain can be put upon the slides, the head turns harmlessly upon the pivot. In this instrument, as in the one first described, the magnifying power which may be used is only limited by the working distance of the objective. Since the upper surface of each slide is held at definite and unvarying distances from the objective, the only allowance that would have to be made would be for the difference in thickness of the objects, cover glasses, and cement rings; so that objectives of the classified scale of ¼ or ⅛ inch might be used without difficulty by those accustomed to the manipulation of a microscope.

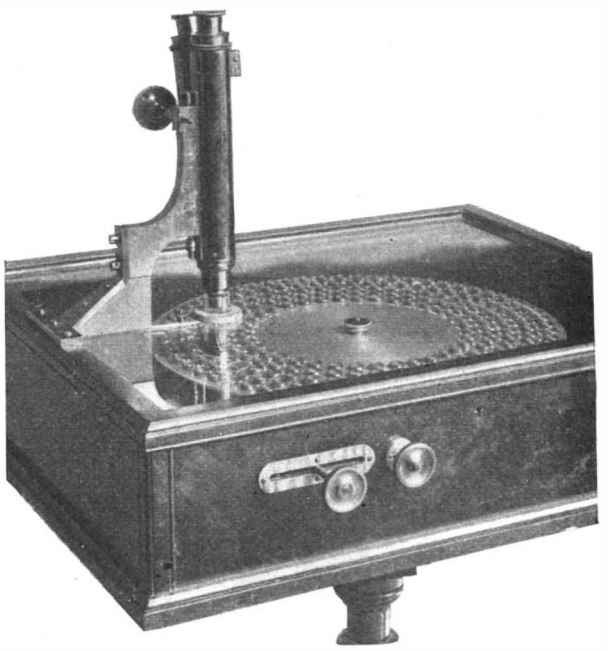
The only disadvantage which the instrument labors under is that the mechanism is somewhat more delicate and complicated than in the other one where the slides are arranged on a circular disk. Microscopes copied from the originals have been in use for several years and no difficulties have been found in the way of their perfectly successful operation. We are indebted to Dr. James M. Flint, of the Smithsonian Institution, for the photographs from which our engravings are made.

Bats in Burmese Caves.

Interesting caves exist at Hpagat, twenty-six miles up the Salween, from Moulmein. They are hollowed out in the base of an isolated limestone hill about 250 feet high, rising precipitously from the river. Capt. A. R. S. Anderson, the surgeon-naturalist, gives an interesting account of these caves in an Indian government report which is abstracted by Natural Science. The entrance is about 12 feet high and is much ornamented by Buddhistic sculptures. As the sun was setting the party took their stand on the sand-spit facing the entrance of the caves and soon saw a pair of falcons leave their perch on the trees and fly to and fro over the river. They were speedily joined by other birds, including common kites and jungle crows, and the entire flock, to the number of sixty or a hundred, flew to the entrance of the caves, close to which they remained wheeling about in midair. A few minutes later the bats began to issue in ones and twos, and were soon pursued by the birds of prey, but appeared to have no great difficulty in eluding capture by their rapid and jerky flight, and their pursuers made no very determined or long-sustained efforts to capture them, but soon returned to their vigil over the cave. A minute or two passed and a sudden rush of wings was heard, and the bats were seen to emerge from the cave in a dense stream which slowly became more and more packed, and continued of about the same density for some ten minutes and then gradually thinned away, until, at the end of twenty minutes, the last had emerged. The stream of bats when at its maximum was ten feet square, and so dense as to closely resemble smoke pouring from a chimney in a gale of wind. This resemblance was increased by the slightly sinuous course pursued by the bats as they flew off into the afterglow. They were so densely crowded that they frequently upset each other and fell helplessly into the river below, where they succeeded in reaching the bank only to fall a prey to the expectant crow. When the great rush occurred the falcons, kites, and crows entered the stream of bats and, flying along with it and in it, seized as many bats as they required for food. Capt. Anderson, by throwing his walking stick into the stream of bats, obtained six specimens. During the last twenty years the bats appear to have considerably diminished in numbers, owing to the depredations of their bird enemies and to their constant disturbance by collectors of bat manure.



DETAILS OF MANIPULATING DEVICES.



CLASS MICROSCOPE ARRANGED FOR EXAMINING FORAMINIFERA.

A Scientific Excursion to Alaska.

Early in May a party of scientific men will be taken to Alaska as the guests of Mr. Edward H. Harriman, of New York. The party will go by special train to Seattle, thence making the inside passage to Sitka; from there the ship goes to Cook's Inlet and around Kadiak Island. A vessel will be chartered and will be equipped for the needs of her scientific passengers. A large complement of guides, packers, etc., will be provided, enabling any member of the party who wishes to leave the ship and explore inland on his own account. Among those who will take part in the expedition will be Prof. Prichard, of the United States Coast Survey, Prof. Coville, of the Department of Agriculture, Prof. C. Hart Merriam, of the Smithsonian Institution, and Prof. William Trelease, of the Missouri Botanical Gardens. The American Museum of Natural History will be represented by Frank Chapman and John Rowley, the Field Columbian Museum by Daniel G. Elliott, Amherst College by Prof. Emerson, Leland Stanford University by Prof. Gilbert. Messrs. R. Swain Gifford and Louis Agassiz Fuertes will go with the expedition as artists.

MESSRS. TIFFANY & COMPANY have succeeded in making a crystal ball 5½ inches in diameter from an American quartz crystal taken from the Old Green Mountain Mine, in Mokelumne Hill, in Calaveras County, California. This is the largest perfect ball that has ever been made of American quartz crystals and is valued at $3,000. The largest Japanese ball ever brought to this country was 7½ inches in diameter. It is not, however, entirely free from flaws.

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THE NAVAL ACADEMY AS IT IS.

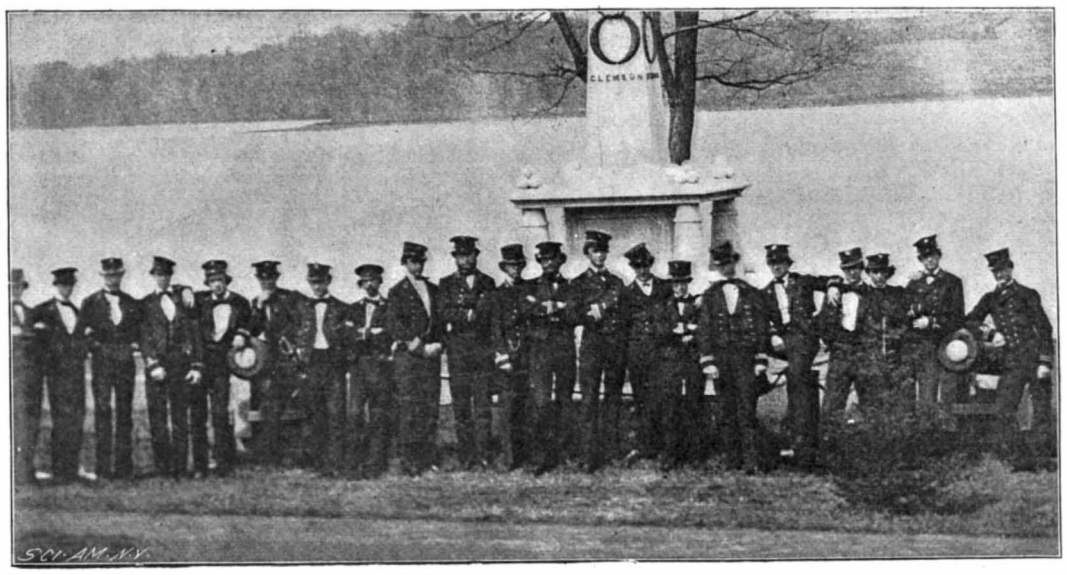
BY PROF. H. MARION, UNITED STATES NAVAL ACADEMY.

The magnificent record made by the American navy in the recent war with Spain has awakened an intense interest among the people of the United States in naval matters in general, and particularly in the Naval Academy, where the officers were educated who won the brilliant victories of Manila and Santiago and who revealed to the world the coming of a new "sea power" of the first magnitude.

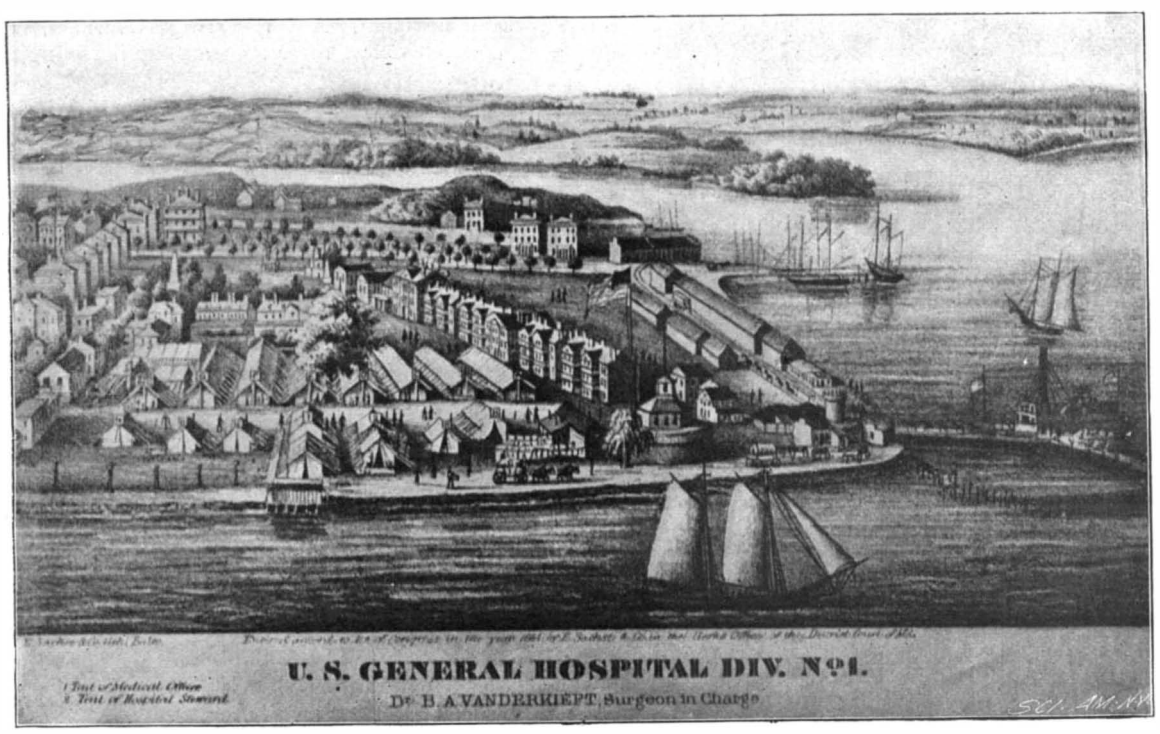
The Naval Academy was founded in 1845 by the historian George Bancroft, Secretary of the Navy during the administration of President Polk. A naval commission selected Annapolis as the site of the proposed school. There it has remained except during the civil war, when it was temporarily removed to Newport, R. I., the grounds and buildings at Annapolis being used throughout the war as an army hospital.

Previous to the establishment of the Naval Academy the midshipmen were taught at various naval stations and on board ship. Various efforts were made from time to time to secure the establishment of a school which should be to the navy what West Point was and had long been to the army; but it was not until 1845 that these efforts were crowned with success and a naval school finally established at Annapolis under the direction of Commander Franklin Buchanan, its first superintendent.

The wisdom of locating the school at Annapolis has been amply demonstrated by subsequent events. Nowhere in the United States could have been found a site more appropriate for this purpose. The mild climate, suitable for outdoor drills all the year round, the quietude and dignity of the old colonial town, with the opportunities for intercourse with its refined and cultured society, all aid in forming from the embryonic naval cadet a courteous gentleman and a healthy, polished, efficient naval officer.



CLASS OF 1861 IN FRONT OF MIDSHIPMEN'S MONUMENT—ADMIRAL SAMPSON IN CENTER OF MONUMENT.



THE ACADEMY TRANSFORMED INTO AN ARMY HOSPITAL DURING THE CIVIL WAR.—From an old print.

The original grounds of the Naval Academy were those of the military reservation of Fort Severn, which had been turned over to the Navy Department, and which consisted of about ten acres. This old fort, a relic of the war of 1812, and the only building of the original naval school that will survive the changes so soon to be begun, was long the dominating feature of the view in approaching the academy from the Chesapeake Bay. It stood at the angle of land formed by the entrance of the Severn River into the harbor of Annapolis and close to the water front, and consisted of a small circular rampart mounting "en barbette" eight heavy guns with a magazine in the center. The ground floor of the old fort was used as a storeroom after it became a part of the academy, and continued to be so used until the building was remodeled in 1895.

Stribling Row, leading from the gymnasium to the old Recitation Hall, was erected between the years 1851–56, and its buildings have been used for cadets' quarters from that time to the present. The western end, since the cadets' "new quarters" were built in 1867, is used by the paymaster's department as a storehouse, and the eastern end as the quarters of bachelor officers. Back of Stribling Row and the gymnasium, at the end of a long wharf that stretches out into the Severn River, lies the old dismantled frigate "Santee," in which the cadets of the fourth class, or "plebes," are quartered on entering the Academy and which is used as a place of confinement for cadets who misbehave during the academic year. In front of Stribling Row is a large campus, extending the whole length of the sea wall. Here the baseball and the football games are played and the cadets are drilled in infantry and artillery tactics.

The new Academic building, which forms part of the general plan of reconstruction of the Academy, will be of magnificent proportions, being 440 feet long and 370 feet deep. Its main entrance will be preceded by a courtyard about 200 feet square.

The Seamanship Department building adjoins the site of the old Recitation Hall. It was built in 1846–47, and enlarged in 1853. This was the mess hall of the early Academy and it was used as such during the stay of the Spanish officers when prisoners at Annapolis. An extensive and interesting collection of models used in the course of instruction in seamanship and naval architecture occupies a large portion of the building. A large model ship, full rigged with sails and spars, extends upward from the first to the second story. This vessel has every rope of the most perfect ship upon its masts and spars, and here such cadets as desire to avail themselves of the privilege find every facility for "learning the ropes."

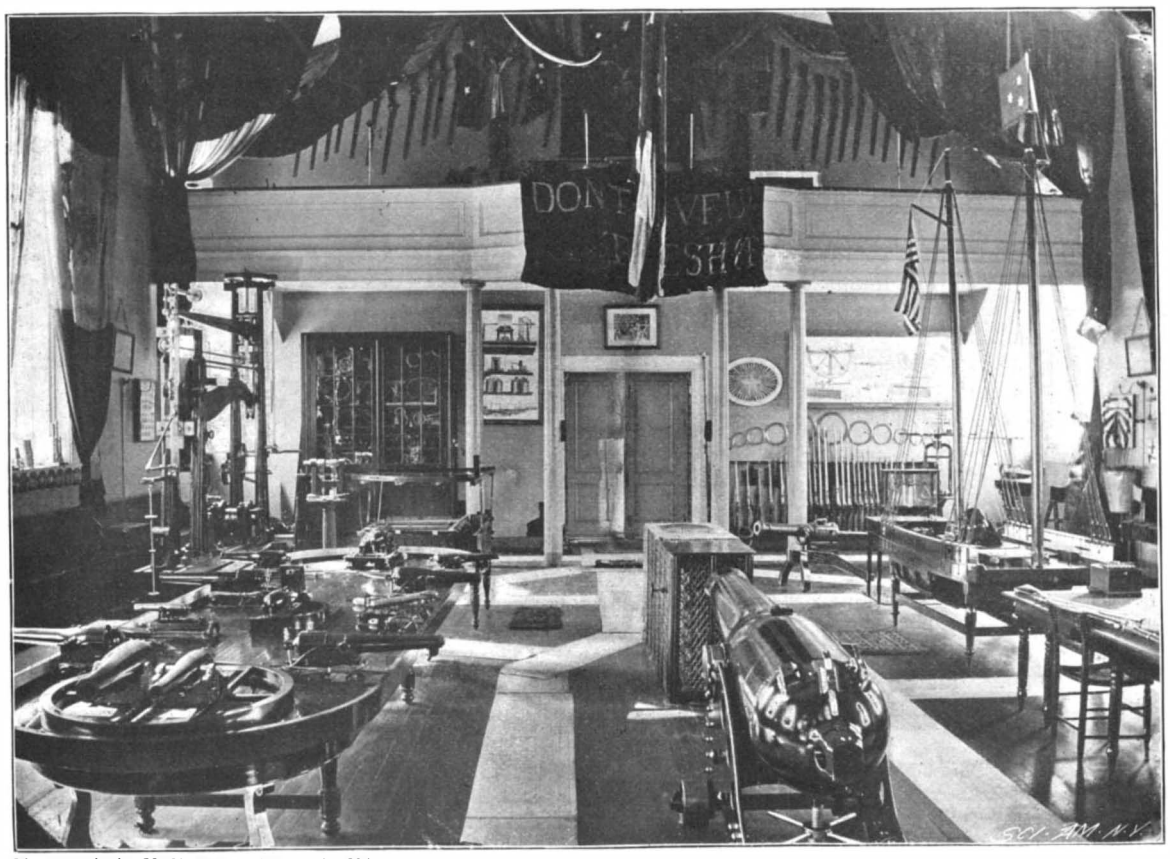
The practical instruction given at the Academy in the various professional branches is very complete, including outdoor drills in seamanship, boats under oars and sail, steam tactics in steam cutters, signals, target practice with revolvers, rifles, machine guns, and great guns, with competition for medals, infantry drills by company and battalion, skirmishers, setting up and bayonet exercises, battery and battalion of artillery, instruction for landing parties, and torpedo firing, practical navigation, deviation of compass, and surveying. The indoor exercises during the winter months include practical ordnance and electricity, steam, gymnastics, boxing, dancing, fencing and sword exercise, instruction in the rigging loft, the machine shop, the boiler shop, the pattern shop, and the model room.

The course of studies covers a period of four years.

During the summer the studies are suspended and the cadets go to sea on a practice cruise lasting about three months, from the beginning of June to the latter part of August. During the month of September they are granted leave of absence to visit their homes and to enjoy a much needed and well deserved rest.

After completing the four years' course at the Naval Academy, the cadets are sent to sea for two years in cruising ships, after which they return to the Academy for a final examination. If successful, after a course in which the principle of "the survival of the fittest" is strictly and impartially carried out, they receive their commissions as Assistant Naval Constructors, Ensigns, Assistant Engineers, or Lieutenants in the Marine Corps, according to the number of vacancies in each branch of the service.

The Lyceum or Naval Institute building, standing next to the Seamanship building, is, perhaps, the most interesting of all the crumbling edifices of the Academy. It was once the chapel of the school and has been successively used as a gunnery room, a museum, a lecture



Photographs by M. M. Casler, Annapolis, Md.

LYCEUM USED AS GUNNERY ROOM (ORDNANCE DEPARTMENT).

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room, a theater, and for the meeting of the Naval Institute. It now contains the nucleus of a museum of American naval trophies. Within the cases on the walls of the Lyceum is a large collection of British flags captured during the revolution and the war of 1812. Conspicuous among the flags is that which Commodore Perry hoisted at the battle of Lake Erie, bearing in large letters the famous words of the gallant Lawrence, "Don't give up the ship!" also the flag that "Old Ironsides," under command of Captain Hull, captured from the "Guerriere" in 1812.

Hanging from the ceiling are to be seen the Spanish flags captured by Admiral Dewey at the battle of Manila, those captured at the battle of Santiago and at Puerto Rico. Among the most interesting of these are the flag of Rear Admiral Montijo, the last one flown by the Spanish squadron at the battle of Manila Bay, from the cruiser "Don Antonio de Ulloa;" the flag of Admiral Cervera from the "Cristobal Colon," captured July 3; and the first Spanish flag hauled down in Puerto Rico by a detachment under command of Lieutenant Huse from the famous little "Gloucester," commanded by Lieutenant-Commander Wainwright, July 25, 1898.

Between the Lyceum and the Seamanship building stands one of the most picturesque ornaments of the Academy. It is the figurehead from the old United States frigate "Delaware," representing the bust of an Indian chief. The cadets have given the figure the nickname of the "God of 2·5," this being the mark out of a possible 4·0 that each cadet has to receive to be satisfactory in his studies and avoid being dropped or "bilged." There is a superstition firmly held by all under-graduates, that by making due obeisance, touching the cap in passing the old chieftain, the requisite 2·5 may be assured. On the other side of the Lyceum stands the "Midshipmen's Monument," which was erected in 1848 by the midshipmen of the navy as a tribute of respect to four of their comrades, two of whom were lost with the United States brig "Somers," one wounded and the other killed in battle near Vera Cruz (1846–47). The accompanying illustration shows the members of the class of midshipmen of 1861 grouped around the monument. The central figure of the group is Admiral Sampson, who graduated at the head of this class.

A short distance from this monument is situated the "Observatory," a very unpretentious looking, old fashioned structure built in 1853.

In the center of the Academy grounds, surrounded by beautiful trees, stands an obelisk, erected to the memory of Captain Herndon, U. S. N., who, while on leave of absence, commanded the steamer "Central America," which was lost at sea. He preserved order, saved the lives of the women and children, and went down with his ship (September 12, 1857).

In front of the cadets' new quarters, flanked by a row of historic cannon captured in Mexico, is the monument erected by subscription among the naval officers to the memory of those who perished in the harbor of Tripoli in 1804. This monument originally stood in the Washington navy yard, and was mutilated by the British during their occupation of Washington in 1814.

With the exception of Fort Severn and a few residences to be remodeled, only one of the original buildings will be preserved. That structure is the Library building, in which is also situated the Superintendent's office.

The Naval Academy Library contains about 38,000 volumes. It is very broad in its character and includes books of all branches of literature.

Opposite the Library is the Chapel, built in 1868. In it are several beautiful memorial windows, and its walls are studded with several monuments to the good and brave, some of whom died in the peaceful branches of the naval profession, others who fell in battle or perished at sea.

The so-called "Cadets' New Quarters," where the first, third, and fourth classes are quartered, the second class being quartered in the buildings of Stribling Row, is the largest building in the present Academy. On the lower floor are the offices of the department of discipline, the mess hall, and several recitation rooms.

The Physical Laboratory and the Steam Engineering building, which face each other at the end of the main avenue, were built in 1866. The former was practically rebuilt in 1877, and, with the improvements made, is now one of the best arranged and equipped laboratories in the country.

These, with the new residences for officers and professors erected in the last addition to the Academy on College Creek and Severn River, constitute the present Academy.

One time it seemed as though the work of reconstructing the Naval Academy would be indefinitely postponed or forever abandoned, but owing to the persistent efforts of Congressman Mudd and Senator Wellington, of Maryland, Congress appropriated at the close of the last session the necessary funds for carrying on the work of reconstruction on the plans proposed by Mr. Ernest Flagg. A contract for over two million dollars for the construction of a new sea wall, the Armory and the Power House has already been awarded, and the work has been actually begun.

One by one the old buildings will be demolished and new structures will take their places. Many are those who will regret the disappearance of the familiar landmarks of the Academy, which are replete with memories of the past. From their ruins, however, will rise an institution which will contain the noblest buildings of any school of its kind in the world and be worthy of the great American nation.

TECUMSEH, THE INDIAN CHIEF. FIGUREHEAD OF THE U. S. SHIP "DELAWARE," 1817.

BUCHANAN ROW.

THE brain of Helmholtz has been examined by Prof. Hansemann, of Vienna. It weighs above the average, but not remarkably so. The convolutions of the brain, however, were extraordinarily complex.

Novel Production of Vortex Motion.

BY C. S. STANFORD WEBSTER, F.I.C., F.C.S.

When the freshly gathered leaves of the native eucalyptus tree (Eucalyptus globulus) are ignited, they project vortex rings in considerable numbers in succession, accompanied by a spluttering noise. The best results are obtained by holding the scythe-shaped leaf vertically and igniting the apex, this being the part where the greatest number of translations are obtained. The leaves experimented upon were some very fine specimens of San Remo production.

Possibly, in the production of these vortex rings, blisters are first formed by the extrusion of the cuticular tissues, and, on the blisters bursting, air or aqueous vapor is spontaneously liberated, the rings being rendered visible on their contact with the smoke from the burning external portion of the leaf. The leaves of the small English variety of eucalyptus possess similar properties to the native product, but in a lesser degree, the rings projected being insignificant in size, comparatively speaking.

It is, of course, quite immaterial in the production of vortex rings whether the smoke or vapor be inside or outside the apparatus, as can easily be demonstrated by placing an empty Tait's apparatus (this consists of a box with a large round hole at one end, the other extremity being covered with a tense sheet of caoutchouc) suddenly in front of a dense cloud of ammonium chloride vapor, and striking the caoutchouc sheet at the same moment. A vortex ring is formed, being rendered visible after its translation through the vapor.

The author uses the vapor obtained by heating the solid ammonium chloride in preference to the usual method in which the two constituents are placed side by side, since the vapor thus obtained is not only denser, and more agreeable to work with, but can be kept under complete control.

If desired to fill the Tait's apparatus with the vapor, the solid is heated in a wide glass tube, one end of which is connected directly with the box by means of caoutchouc tubing, and to the other end a narrow glass tube is attached, and bent back parallel with the volatilizing tube, so that the same flame heats both simultaneously; this narrow tube then terminates in a long caoutchouc tube used for blowing into. By gently blowing into the glass apparatus the respired air is heated, and at the same time drives the volatilizing ammonium chloride into the box, which is quickly filled with the vapor.—Chemical News.

Date Palms for Arizona.

Dr. Zwingle, representing the Department of Agriculture of the United States, is now in Morocco on a mission which the department hopes will open a new and profitable industry in the most arid sections of our Southwest. It has been found that date palms with some irrigation will grow as well in Arizona as in Arabia. This was discovered many years ago, says the Evening Post, by early Mormon settlers, but the trees were not of the best variety, and date growing never developed as an industry. Now, however, the department is prepared to push the experiment on an extensive scale, and Dr. Zwingle is making a full study of the African date palm, selecting the very finest varieties and those best adapted to our arid region. Young trees will be shipped to Arizona and will be planted and cared for by experts from the department. They will cost about $5 each laid down in Arizona.

The Bacteriology of a Railroad Car.

Accidents are not the only danger in railway traveling. Several years ago the bacilli of tuberculosis was discovered in a German railway carriage. Since that time Dr. Petri has carried on, in the laboratory of the Imperial Sanitary Bureau at Berlin, exhaustive researches on the presence of pathogenic bacilli in railway carriages. These reports showed that expectoration was the chief source of danger. Of 91 animals which were inoculated with the sputum, 28, or 30·8 per cent, succumbed to disease produced by the inoculated material; the other 63 animals were killed at the end of six weeks, and of these three were found to be suffering from tuberculosis, manifestly due to the inoculation. The Prussian Minister of Public Works has now issued an order giving the proper method of cleaning and disinfecting railway carriages and platforms.

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THE SAMOAN ISLANDS.

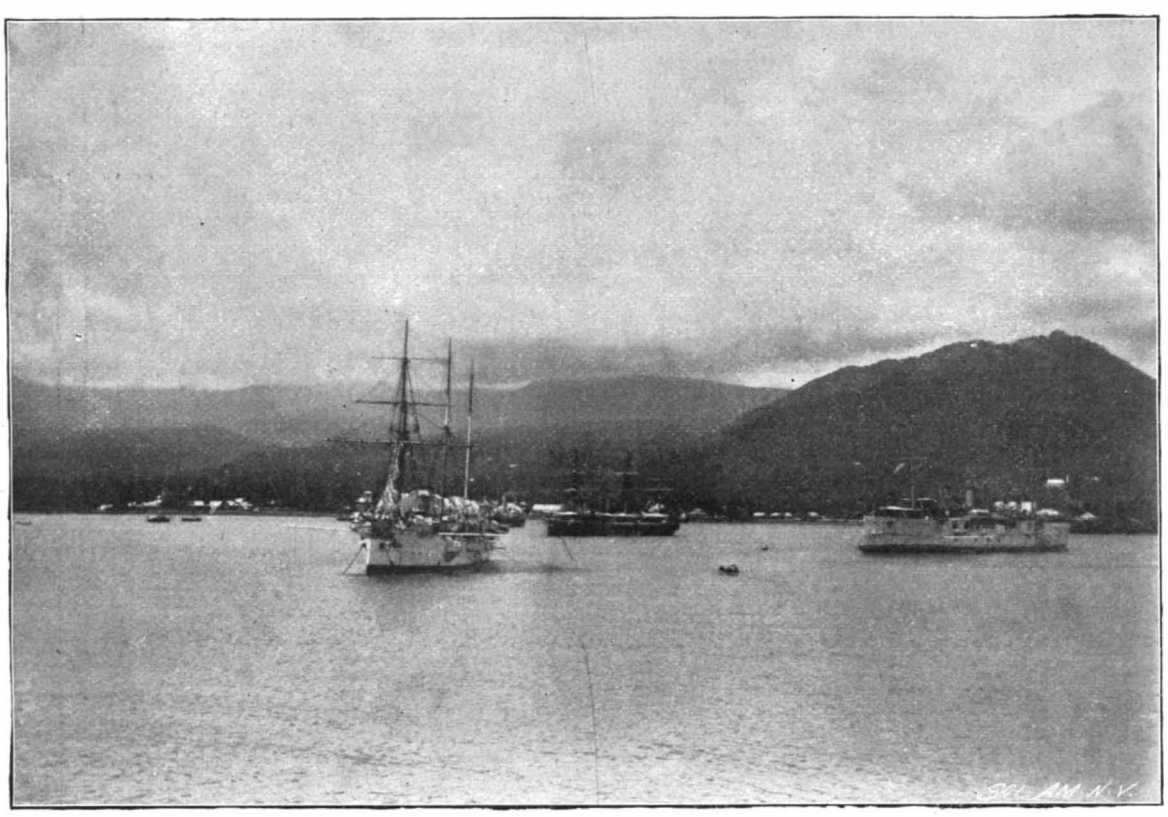
The annexation of Hawaii has more than ever made it important for us to sustain our rights in the Samoan Islands, for they are located about 2,000 miles south and 300 miles west of the Hawaiian Islands. They lie in an almost direct line between San Francisco and Australia and slightly south of the direct steamship route between the Philippines and a possible interoceanic canal. The group consists of ten inhabited and two uninhabited islands. Their area is about 1,700 square miles, and the population is about 36,000, of whom less than 500 are Americans or Europeans. The islands are volcanic hills rising precipitously from the beach, and the tropical vegetation is very dense and of an intensely vivid green, characteristic of the tropics. The islands are fertile, producing cocoanuts, cotton, sugar, and coffee. The most important product is cocoanuts, from which the "copra" of commerce is obtained, which is used in the manufacture of cocoanut oil.

The Samoan Islands have had a checkered existence and have been from time immemorial under two royal houses, but a number of years ago Malietoa became sole king, and in 1877 he was deposed by the German government upon the claim of unjust treatment of German subjects, and he was deported to German New Guinea, and finally to Hamburg. A native chief was proclaimed king by the Germans, notwithstanding the protestations of the British and American consuls. Mataafa, a near relative of Malietoa, made war upon the native chief who had assumed the kingship, and wrested the throne from him. In 1889 a conference between the representatives of the three powers most closely interested was held at Berlin, in which a treaty was signed by the American, British and German officials, by which they guaranteed the neutrality of the islands, so that the citizens of the three signatory powers would have equal rights of residence, trade and protection. They agreed to recognize the independence of the Samoan government and the free right of the natives to elect their king or choose their own form of government. A supreme court was established, consisting of one judge, who, at present, is an American, Mr. W. L. Chambers. To this court is referred all important suits.

Malietoa was restored as king in 1889 and continued on the throne until 1898, when he died. The consuls of the three powers, with the chief justice as president, then took charge of the administration, pending the election of a successor. It is out of that election and recognition of the successor of King Malietoa that the recent disagreement between the representatives of the three governments maintaining joint protectorate over the islands has occurred, and the insurrection of the natives, which has resulted in the death of several British and American officers and men.

A combined British and American landing party was ambushed on a German plantation near Apia, on April 1. The British and Americans numbered 105, and they were surrounded by 800 Mataafans. The automatic gun of the allies became jammed, and had this not occurred it is probable that the result would have been different. After a desperate fight the American and English force was driven to the beach, where they were protected by the guns of the British and American warships. The dead were mutilated by the natives; their heads being cut off. Four Americans and three British were killed. Our engraving represents the war vessels of the three powers in the harbor of Apia. At the right is the United States cruiser "Philadelphia," next is the British cruiser "Porpoise," while on the extreme left is the German cruiser "Falke." The British gunboat "Tauranga" was also present. After the ambuscade, negotiations were started which ended in an agreement which insured the departure of three commisions for Samoa, one delegated by each nation, armed with powers by which they were not only judges but governors, superseding the consul-generals, and their decrees are to be the supreme law of the land, subject to the general act of Berlin for the tripartite government of Samoa.

The natives of Samoa live in rude huts usually surrounded by an inclosed yard, which is paved with small pieces of lava. The floors of the dwellings are of the same material, over which woven mats are spread, covering the sharp points of the stones which form the floor. The houses rest on central and outer posts, and the space between these is shut off by means of palm leaf mats so as to keep out wind and rain and to provide protection at night. The framework of the roofs is covered with leaves of the sugar cane which are very skillfully put together. The harbor at Apia is surrounded by coral reefs which are the cause of many shipwrecks. The Samoans, who spend a great deal of their time on the water, know these reefs thoroughly, and their services are invaluable to navigators. The natives are seldom seen in their original costume, and the men as well as the women of those regions which are most visited by foreigners wear a skirt-like garment and a light jacket. Most Samoans of sixteen or more are tattooed in spite of the painfulness of the process and the opposition of the missionaries.



WAR VESSELS IN APIA HARBOR—THE "FALKE," "PORPOISE," AND "PHILADELPHIA."

NATIVE SAMOANS AND THEIR HUTS.

A New Use for Toy Balloons.

The increasing risk of collisions at sea, with all their terrible consequences, stimulates the interest that would in any circumstances be aroused by a rational proposal for reducing the danger of death by drowning. A Frenchman, M. Charles Janet, has recently carried out experiments at Beauvais with the object of proving that by means of India rubber "balloons," as children call them, which may be carried in a very small compass and rapidly filled with air in time of danger, a person who knows nothing of swimming can keep afloat in the roughest water. Nothing could be more simple than the apparatus, and it can be put into a box no larger than a lady's purse. It consists of a yard or so of whipcord, to which are attached four "balloons," rolled up, and what is necessary for blowing them out, and keeping them afterward air-tight. The balloons should be filled only to about half of their full extent, so that they may offer sufficient resistance to the waves. This resistance is very remarkable considering the lightness of the material. M. Janet's children having fastened the apparatus just described to the upper part of the body, jumped into water thrown into violent commotion by the opening of sluice gates, and although they were whirled in the eddies and drawn under by the force of the current, their disappearance was only momentary, whereas strong swimmers in the same circumstances would have run the risk of drowning.

The Current Supplement.

The current SUPPLEMENT, No. 1218, has many articles of great interest. "The Ice-Breaking Steamer 'Ermak'" describes the singular vessel which is to be used for battling with ice in the Baltic. The construction is fully illustrated. "The Secret History of Smokeless Powder" is an interesting and important paper revealing many facts connected with its history not hitherto known. The second lecture in the University of Pennsylvania course, entitled "Peculiar Laws and Customs in the American Colonies," was delivered by Dr. Herman V. Ames, Instructor in American Constitutional History at the University of Pennsylvania. The first installment is published this week. "The Mine Defenses of Santiago Harbor" is a valuable article by Lieut. E. E. Capehart, and is an authoritative account of all the mines which protected that harbor during its blockade. Zickler's "System of Electro-Optical Telegraphy" is also fully described.

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RECENTLY PATENTED INVENTIONS.

Bicycle-Appliances.

VELOCIPEDE-PEDAL.—EUGENE GERMAINE, Paris, France. The main object of this invention is to provide improved means for attaching the pedal to the axle, so that connection and disconnection can be quickly and readily effected. The pedal is provided with a novel arrangement of axle, cones, removable cross-piece, and spring-pressed telescoping ball-cups. The particular arrangement of parts described causes the balls to be forced into contact with the cones, and enables the pedal to be readily connected and disconnected.

BICYCLE-LAMP BRACKET.—CHARLES E. WHITMARSH, Brooklyn, New York city. With ordinary fixed lamp-brackets, it often occurs that when the bicycle is in a leaning position, the lamp will smoke or the oil will run out. The inventor overcomes this difficulty by providing an arm upon which the lamp is secured, suspended from a pivot, so that the center of gravity of the lamp is beneath the pivot, thus causing the lamp always to maintain an upright position.

Electrical Apparatus.

ELECTRIC CURRENT CONTROLLER.—JAMES B. BREEDING, San Antonio, Tex. This inventor has provided a device by means of which an incandescent electric lamp may be caused to burn with varying brilliancy, and by means of which the use of fine wires is avoided, thus preventing the controller's being burnt out. A number of resistance-blocks arranged in the form of a cylinder, are connected in series, and are disposed between insulated caps. A rod extends longitudinally through the blocks, but is insulated therefrom, and forms part of an electric conductor. A contact carried by one of the caps, is adapted for electrical connection with the blocks; and a conductor leads directly from the blocks. The position of the contact with relation to the other parts determines the amount of current fed to the lamp.

Mechanical Devices.

ROAD-GRADING AND DITCHING MACHINE.—JAMES W. CORNETT, Gaveston, Tex. The machine comprises a plow provided with a moldboard having its outer end formed with an upwardly-turned flange, and having an inclined chute upon which the moldboard delivers. A wheeled carrier is located at one side of the plow, and supports an elevator-frame, having its inner end pivotally connected with the moldboard of the plow below the chute. An elevator-belt is mounted in the frame and is operated from the wheel of the carrier. The machine is arranged to remove the plowed up soil a distance from one side of the machine and to permit the working-parts to be thrown out of gear, while the machine is being moved from place to place.

WINDMILL.—LOUIS K. HONG, Parkland, Wash. The windmill is constructed of iron and steel, and is, therefore, light, yet strong and rigid. A governor is provided which causes the wheel to maintain a uniform speed of rotation. By means of a combination of double gears and shafts, the rotary motion of the windwheel shaft is transmitted to the line or driving-shaft, side-drafts being prevented. The windwheel is balanced and held squarely to the wind by a rudder-vane so constructed and so attached to the turn-table as to prevent all swaying to and fro when at rest or at work.

PHOTOGRAPHIC PROJECTING MACHINE.—WILLIAM V. MILLER, Bayonne, and GEORGE P. RICE, Rutherford, N. J. In chronophotographic apparatus, as hitherto constructed, no little difficulty has been encountered in overcoming the vibration of the film, due largely to the placing of the film-feeding wheels above and below the slide-opening. The inventors of this improved apparatus overcome this vibration by using a feed-mechanism, comprising two spaced and intermittently rotating wheels mounted on independent shafts and engaging the film on opposite sides of the slide or exposure-opening. The film is hence not loose at the opening, but is locked at this very point by the feed-mechanism during the period of rest, and is bodily moved at this point by the same means during the period of feeding. As the feed-mechanism is rigidly locked with the film, there can be no vibration to mar the effect.

TYPE-WRITING MACHINE.—CORAL N. WESTWOOD, Nanaimo, British Columbia, Canada. It is the purpose of this invention to provide improved means for column, line, and back spacing in type-writing machines. The invention is embodied in mechanism attached to the right-hand side of the machine, and so connected with the rotary platen and its reciprocating carriage as to adjust one or both as required for effecting column, line, or back spacing. The connections in question consist of a transverse shaft, a ratchet-disk mounted thereon and a pawl engaging the disk. The shaft and disk can be shifted to release the disk from engagement with the pawl. The platen-frame can be connected with the shaft, so that the latter turns as the former slides. A stop-mechanism is applied to the shaft, for arresting its rotation as the frame reaches the desired point.

Railway-Appliances.

TRAIN-DISPATCHER'S INDICATOR.—ROBERT F. ADAMS, Horse Creek, Ala. This inventor has provided an indicator for the use of train-dispatchers, which is a miniature representation of a railroad with its stations and trains, and reproduces objectively the positions and movements of the various trains at different points along the road. This way of locating a train is an improvement over the more uncertain and difficult method of consulting figured charts.

FOLDING CAR-STEP.—NELSON GRAY, Louisville, Ky. The improvement devised by this inventor provides a folding car-step which can be inverted, and which is provided on its under side with a platform-section, constituting an extension of a car-platform when the steps are inverted and out of position. Lock-devices for the operating-lever and for the latches which secure the step section in folded position, are also provided. At the outer end of the platform a gate is mounted, which is automatically opened and closed by the movements of the folding step-section.

Miscellaneous Inventions.

LETTER-FILE.—SAMUEL M. BRYDGES, Nelson, Canada. This letter-file is made so that it can be opened after the manner of a book. The back of the file is a trough, the sides and one end thereof being rigid. A hinged member serves to close the other end of the back and is mounted to swing on the back. Side portions are connected with the back to swing thereon; and a transverse pin is secured in the back. Letter-holding strips are provided, which are slotted to engage the pin, the hinged member of the back serving normally to prevent end displacement of the letter-holding sheets.

SAFETY ATTACHMENT FOR ELEVATORS.—GEORGE FOX, 2d, Manhattan, New York city. In the construction of an elevator according to this invention, channel-beams are provided, adapted to form at the outer faces of the sides guideways for the cage to travel in, and to form at the inner faces of the sides contact-surfaces. Cams are carried by the cage and are arranged to move normally free between the sides of the channel-beams and to impinge thereon in order to stop the cage in case of an accident. As the inner faces of the sides of the channel-beams are not lubricated, it is evident that the cams brake the cage on which they are carried. The cams may be operated either manually or automatically.

ACETYLENE-GAS GENERATOR.—JAMES H. DYSART, Alexandria, and PAUL M. DYSART, Pittsburg, Pa. This acetylene apparatus consists of a generator and two gasometers connected by pipes. The generator is provided with a floating carbid-chamber, which, by means of a lever, automatically controls the flow of water. One of the gasometers is also connected with a valve in the water supply pipe in order to regulate the flow of water. When, therefore, the pressure of gas becomes excessive, these automatic means will temporarily shut off the water until the pressure has become normal.

CLOTHES-LINE SUPPORT.—THOMAS VARCOE, Lead City, S. D. The support has a head which comprises a pillar or body portion carrying a fixed jaw coacting with a movable jaw having a slotted shank. A pin is carried on the pillar or body-portion and enters the slot of the shank. A latch holds the movable jaw in closed position. A line once imprisoned between the jaws will be so sustained that whatever may be the burden imposed upon it, it will be impossible for the clothes to be brought into contact with the ground.

TRUNK.—HARRISON M. TURNER, Birmingham, Ala. To provide a means whereby a series of drawers may be arranged within a trunk, so that they may be lifted easily and compactly to the top, and held so as to be conveniently accessible, is the purpose of the present invention. The means in question consist of lazy-tongs attached to the body and to the drawers-receptacle, and operated by means of a handle. A locking-device secures the tongs in distended position.

PHOTOGRAPHIC-PLATE HOLDER.—HENRY H. ALTSCHWAGER and LOUIS E. JOY, Minneapolis, Minn. This improvement relates to a peculiarly constructed plate holder, the back of which is hinged like a door and supports on its interior side a movable sensitive plate frame, operated by a pinion whose shaft extends through the door at the back and ends in a knurled knob, whereby the sensitive-plate-holding frame may be rotated in the holder and moved vertically and horizontally. Directly in front of the plate is a kit having a small rectangular aperture, and in front of this is a small slide. When the holder is clamped to the rear of the camera, the small slide is drawn and an exposure is made on one corner of the plate. Then the slide is shut and the plate in its frame inside the holder is moved forward horizontally one notch by rotating the pin, when another picture can be made. Diamond-shaped negatives are made by having the plate moved at an angle to the vertical lines of the rectangular opening in the kit. There is a suitable indicator and locking device on the outside of the knob to show the operator how much of the plate has been used. It appears to be a very useful and practical arrangement for the easy production of small negatives with one lens.

HAND PUMP FOR EXTRACTING KEROSENE OR OTHER LIQUIDS FROM TINS.—WILLIAM JOHN RAWLING, Adelaide, Australia. This is a simple tube pump intended for use in commercial oil-cans in which oil is exported. It has on the upper end soldered to the tube at right angles a spike which is used for first puncturing a hole in the top of the can. Then the barrel of the pump is pushed through the hole until a spiral or other device soldered to the waist of the barrel is reached; a turn or two of the barrel works the spiral into the hole under the top of the can, holding the barrel firmly so that the lower end comes nearly in contact with the bottom of the can. A plunger-valve of simple construction attached to the usual reciprocating pump-rod is employed. There is also a fly-valve in the bottom of the barrel. A spout with a teapot-shaped nozzle prevents drip and causes the oil to run back into the can after the pump is stopped. When the can is emptied the pump can be readily removed and applied to other cans.

Designs.

SEWING-MACHINE HEAD.—SPENCER A. STONE, Chillicothe, Mo. The machine-head consists of a human leg and foot, the thigh being flexed at a right angle to the lower leg.

WICK-TRIMMER.—SUMNER A. HOVEY, Stoneham, Mass. The trimmer consists of a body which is adapted to fit over the wick-holder of a student's lamp, and which is provided with circularly-disposed knives. By rotating the body-portion, the knives will trim the wick uniformly.

MEMBER FOR MATCH-LIGHTERS. WILLIAM M. LARSEN, Decorah, Iowa. The leading feature of the design consists of a member having a roughened surface, lugs, and a beveled flange. Over the lugs and over the flange another member is adapted to fit; and between the two members the matches are held. By pulling out a match, the phosphorus head is rubbed against the roughened surface, thereby causing the head to burn. It is therefore evident that the action of drawing out a match is immediately followed by the lighting of the phosphorus.

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References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Minerals sent for examination should be distinctly marked or labeled.

(7652) J. F. W. C. asks: Who was the inventor of, or the first that made malleable iron? A. The process of converting cast iron into malleable iron was known in 1722 and described by Reaumur. Patents were issued for the process to Lucas, in England, in 1804, and again to Brown and Lennox, about 1850. Malleable iron was made at Elizabethtown, N. J., in 1835.

(7653) F. L. M. writes: Three men want to carry a log 18 feet long, of equal weight throughout, one man at the end, the other two to use a cross stick. How far from end should this stick be placed so that all would carry an equal weight? A. The stick should be placed 4½ feet from the end of the log in order that the two men holding it should carry each ⅛ of the weight of the log, and the man at the other end should carry the same weight, ⅛ of the log.

(7654) L. C. L. writes: 1. I intend making a small magneto-electric machine. Can I wind the armature with double-covered wire? If so, what size is best? A. For your small magneto use any size from No. 24 to 30 single cotton-covered wire as may be convenient. 2. How long will a concentrated solution of metol-quinol developer keep its strength if kept in a well corked bottle? A. We cannot tell you how long a solution of metol-quinol developer will keep in a well corked bottle. To find out you have only to put some in a bottle, put the cork in firmly and await the result. 3. Do negatives on celluloid films require varnishing? If so, what is the best composition? A. Gelatine negatives do not require varnishing, though they may be varnished with any good negative varnish. 4. What proportion of zinc and lead will make an alloy hard enough to use for the cylinder casting of a small steam engine? A. No alloy of zinc and lead is very hard.

(7655) D. A. McD. writes: I have some small pieces of marble ¼ inch thick around my fireplace; they were cemented to the brick to make nice finish. They have come loose and need cementing again. Can you tell me what kind of cement to use that will hold the pieces in place and the fire will not cause to come loose. A. Soak plaster of Paris in a saturated solution of alum in water; bake in an oven; reduce it to a powder; mix with water and apply; it sets very firmly.

(7656) L. J. M. asks for a receipt to make hard putty such as carriage painters and jewelers use. A. Try the following: Boil 4 pounds of brown umber and 7 pounds of linseed oil for two hours; stir in two ounces of beeswax; take from the fire and mix in 5½ pounds of chalk and 11 pounds of white lead; the mixing must be done very thoroughly.

(7657) J. M. F. writes: Among those who live by the sea the belief is very prevalent that the tide influences the wind, and that a wind is more likely to rise or fall or change on high or low tide than at other times of the day. Is this a fact? And if so, what is its physical cause? A. The belief is no doubt well founded, for the displacement of the air over the sea near the shore by the rising tide naturally tends to move it toward the shore and over the land, while the falling tide draws the air from the land to fill the displacement made over the sea. The effect is very small with ordinary tides, but should be very perceptibly felt on the shores of the Bay of Fundy, where the tidal range is from 30 to 60 feet.

NEW BOOKS, ETC.

LIQUID AIR AND THE LIQUEFACTION OF GASES. Theory, History, Biography, Practical Applications, Manufacture. By T. O'Conor Sloane, Ph.D. New York: Munn & Company. 1899. Pp. 365. 12mo. Illustrated. Price $2.50.

No subject, save perhaps wireless telegraphy, is attracting as much attention at the present time as liquid air. Heretofore the literature upon the subject has been entirely in the form of articles in the scientific and technical journals and papers in the proceedings of learned societies. It has been reserved for Dr. T. O'Conor Sloane, the well known writer on physics, to bring together the theory and the facts concerning the liquefaction of gases in the form of a book, and he has performed his task with great ability, and the volume has been entitled "Liquid Air and the Liquefaction of Gases." It deals with the theory, history, biography, applications and manufacture of liquid gases. First the subject of physics is taken up, and this is followed by chapters on Faraday, Pictet, Cailletet, Von Wroblewski, Olszewski, Dewar and Tripler. In these chapters the author has successfully blended biographical notes with a succinct account of the physics and chemistry of the subject. Then follow descriptions of various forms of apparatus for making liquid air, experiments tried with liquid air, and some applications of low temperature. The entire history of the liquefaction of gases from the earliest times to the present is adequately treated, and this is supplemented by an illustrated description of experiments that have excited the wonder of audiences wherever liquid air has been experimented with. The book is handsomely illustrated, including portraits of pioneer investigators, and further details concerning it will be found in another column. The publishers of the SCIENTIFIC AMERICAN feel, in offering this book to the public, that it is issued at a most opportune time.

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APRIL 25, 1899.

AND EACH BEARING THAT DATE.

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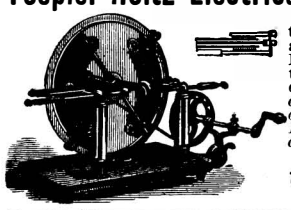

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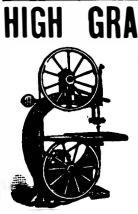

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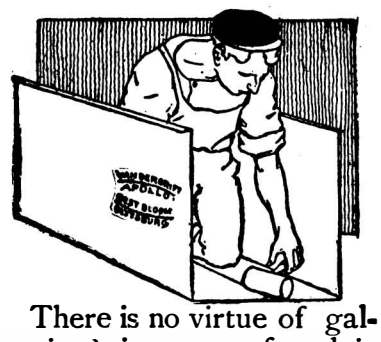

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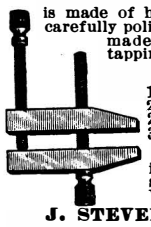

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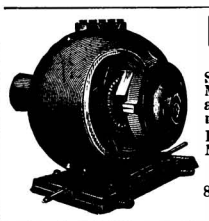

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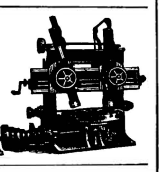

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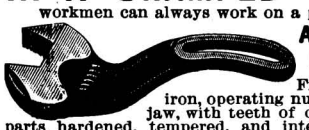

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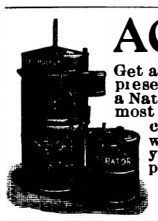

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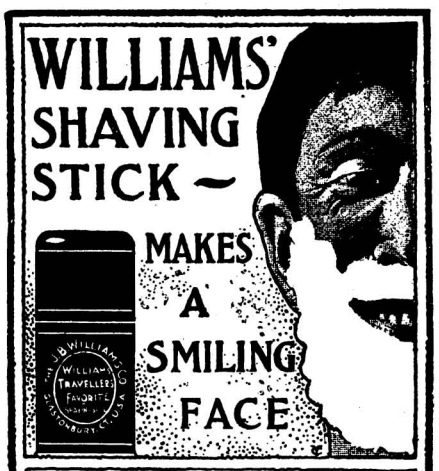

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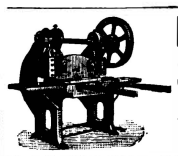

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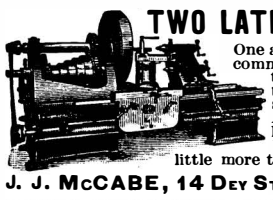

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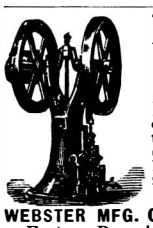

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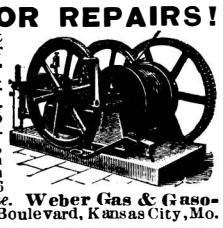

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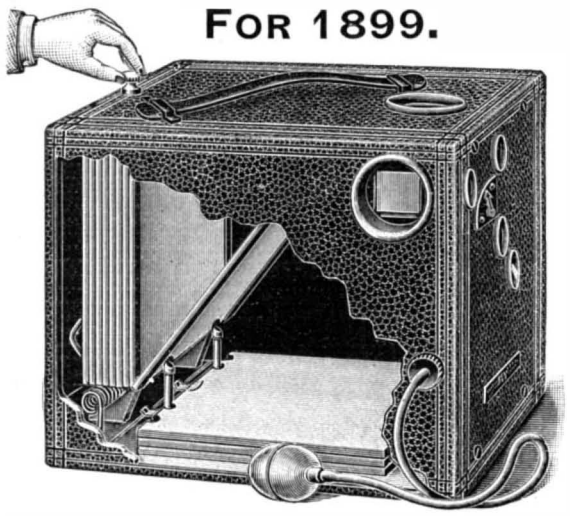

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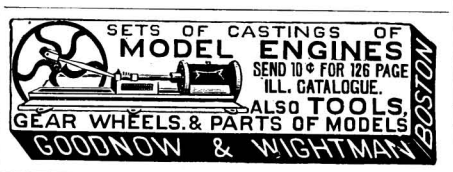

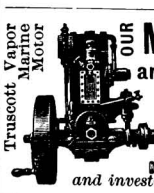

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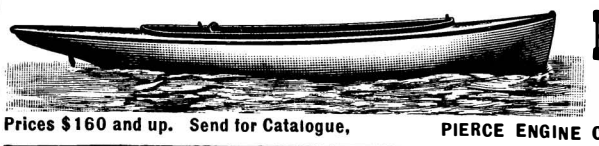

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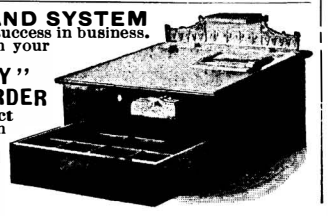

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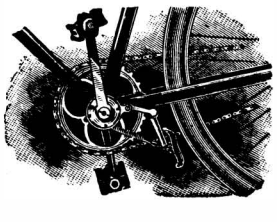

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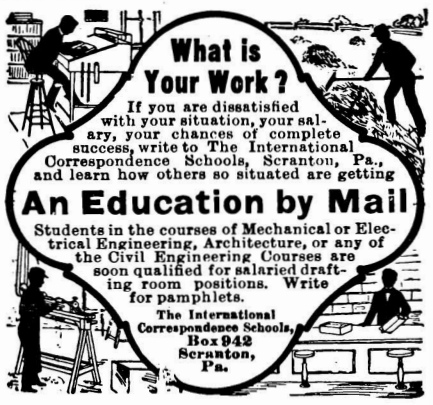
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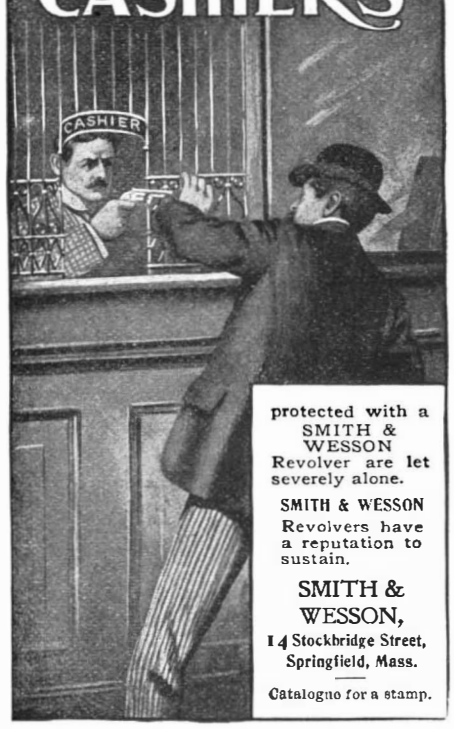
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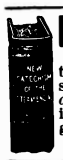

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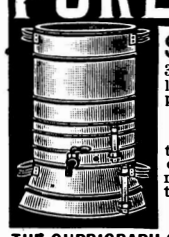

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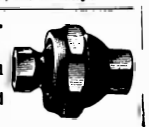

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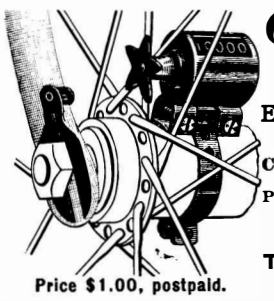

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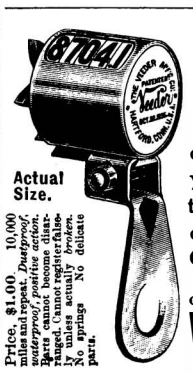

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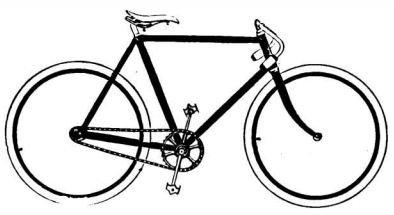

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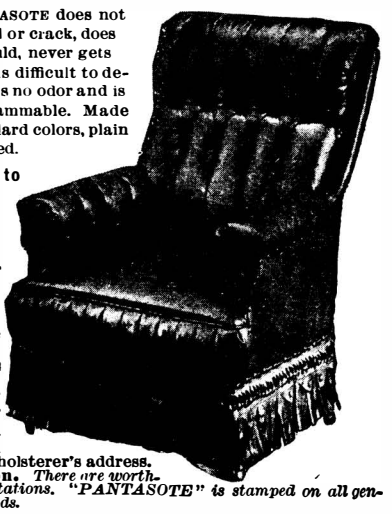

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